

REPORTER AT LARGE

MICROWAVES-II

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ONE of the most controversial figures to emerge from the tangle of controversy surrounding biological effects of microwaves in the last decade has been Dr. Mil-M. Zaret, an ophthalmologist practicing in Scarsdale, New York, and a clinical associate professor of ophthalmology at the New York University-eyrie Medical Center. Dr. Zaret's involvement with microwaves began in 1959, when he was asked to conduct a study to determine the occurrence of defects and cataract formation in the eyes of radar technicians and microwave workers employed in the armed forces and in the defense industry. Cataracts were known to occur in the eyes of workers exposed to infrared radiation, and had been produced in the eyes of animals exposed to microwave radiation; in addition, there was then a documented case in which microwave radiation had been determined to be the cause of cataract formation in a microwave worker. Carried out as a joint effort by the medical departments of ophthalmology and industrial medicine, the survey was ordered by the Air Force, and was undertaken as part of the Tri-Service program—a four-year investigation of biological effects of microwave radiation which was conducted by the three branches of the Department of Defense. It marked the start of a long era of discovery for Zaret, who usually came to believe that microwave radiation and other radio-frequency waves posed a far greater health hazard than anyone had ever suspected. Between the spring of 1960 and the spring of 1963, Zaret examined the eyes of a selected population of nearly ten hundred workers who were employed at sixteen military and civilian installations in the United States, Alaska and Greenland, including Army, Navy, and Air Force bases, missile-launching facilities, radar-research-and-

development laboratories, and factories in which radar systems were being assembled. To insure that Zaret's findings would be made on a wholly objective basis, there were some workers who had been exposed to microwaves and some, as control subjects, who had no history of exposure; and Zaret proceeded to examine them all without knowing who had been exposed and who had not. In every case, an ophthalmological history of the patient was obtained to determine whether there was any hereditary predisposition to cataract formation; the patient's eyes were tested for visual acuity; the lenses of his eyes were examined with a slit lamp, which is a type of microscope that beams light into the eye and makes it possible to scrutinize the lens in minute detail; and three-dimensional photographs of each lens were taken. When the survey was completed, no cataracts were found, but there was a slight excess of minor defects in the lenses of the group exposed to microwaves. Since Zaret knew from clinical experience that such imperfections were not the precursors of cataracts but merely an indication of the normal effect of aging upon the lens, he concluded that they did not serve as an indicator of cumulative exposure to microwaves and were of no clinical significance in determining whether or not microwave workers were at special risk of developing cataracts. Moreover, he noted that since it was impossible to establish with any accuracy the microwave levels to which the workers had been exposed, no conclusions could be drawn from the survey about the safety of the ten-milliwatt level—the standard of exposure that had been adopted by the military in 1957 and 1958. For these reasons, he stated in his final report that a proposed follow-up survey of lens imperfections in these patients would serve no useful purpose, and he recommended that it not be undertaken.

Although the results of the three-year survey were inconclusive, Zaret had made some unusual observations in the course of it that in time profoundly altered his own thinking about how microwaves could affect the eyes. "Right off the bat, I saw something very strange," he said not long ago. "In April of 1960, while I was conducting a pilot study of forty-odd radar workers up at Griffiss Air Force Base, in Rome, New York, I examined a young man in his early twenties who had a cataract on the posterior portion of the lens as well as areas of opacity on the posterior capsule. Now, the capsule is a transparent elastic membrane about ten microns—or one twenty-five hundredth of an inch—thick which surrounds the lens the way a cellophane wrapper surrounds a piece of candy, and only in extremely rare circumstances do cataractous changes occur in it. The only capsular cataracts I had ever come across had occurred in glassblowers and other workers exposed to the intense heat of infrared radiation, and those cataracts, as might be expected, had developed on the anterior, or front, portion of the capsule. In fact, I had never seen a cataract on the posterior capsule of an otherwise healthy eye before, and I didn't know what to make of it. Since the young man was a juvenile diabetic, however, and since diabetes is known to be a causative factor in the formation of cataracts, there were no conclusions to be drawn from the case. I made a note to re-examine him, but unfortunately he died in the meantime. He was found unconscious at the foot of a microwave relay tower, and he died in what was diagnosed as a diabetic-related uremic coma."

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ONE of the most controversial figures to emerge from the tangle of controversy surrounding the biological effects of microwaves over the last decade has been Dr. Milton M. Zaret, an ophthalmologist practicing in Scarsdale, New York, and a clinical associate professor of ophthalmology at the New York University-Bellevue Medical Center. Dr. Zaret's involvement with microwaves began in 1959, when he was asked to conduct a survey to determine the occurrence of lens defects and cataract formation in the eyes of radar technicians and microwave workers employed in the armed forces and in the defense industry. Cataracts were known to occur in the eyes of workers exposed to infrared radiation, and had been produced in the eyes of animals exposed to microwave radiation; in addition, there was by then a documented case in which microwave radiation had been determined to be the cause of cataract formation in a microwave worker. Carried out as a joint effort by the medical center's departments of ophthalmology and industrial medicine, the survey was financed by the Air Force, and was undertaken as part of the Tri-Service Program—a four-year investigation of the biological effects of microwave radiation which was conducted by the three branches of the Department of Defense. It marked the start of a long voyage of discovery for Zaret, who eventually came to believe that microwave radiation and other radio-frequency waves posed a far greater health hazard than anyone had ever suspected.

Between the spring of 1960 and the spring of 1963, Zaret examined the eyes of a selected population of nearly sixteen hundred workers who were employed at sixteen military and civilian installations in the United States, Alaska, and Greenland, including Army, Navy, and Air Force bases, missile-tracking facilities, radar-research-and-

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"Two men showed pronounced swelling of the lens," he said. "Such swelling usually occurs within two weeks of some acute injury or trauma to the eye, so I went to the health-and-safety people at the base and asked them what each of these men had been doing recently. Sure enough, there was an accident report on file for them. It turned out not only that they worked together but that ten days before, while they were working on some microwave generators that had supposedly been shut down, sparks began flying from their screwdrivers. This meant that their tools were acting as receiving antennas, and that they themselves were being irradiated with microwaves. The very nature of their injuries indicated that they had been exposed to power densities that must have greatly exceeded ten milliwatts per square centimetre. The incredible thing to me was that neither of them could remember feeling anything. Up till then, everyone had always assumed that an amount of microwave radiation sufficient to cause acute injury such as swelling of the lens would also produce the sensation of heat, which microwaves are known to produce in tissue, and that this sensation of heat would be especially felt by the eye, which is exquisitely sensitive to pain. Indeed, part of the mythology long accepted by microwave workers was that you couldn't be hurt by a microwave beam, because you would always be able to feel heat and get out of the way. Yet these two workers insisted that they hadn't felt a thing. It was an ominous finding indeed, for it meant that microwaves could act insidiously to cause serious injury."

As it happened, at about this time several large electronics and communications companies that were taking part in the survey of lens imperfections began sending to Zaret for private consultation employees who had already been diagnosed by other ophthalmologists as having cataracts. "I saw half a dozen such cases in 1961 and 1962," Zaret said. "These patients were sent to me because there was a question as to whether they had been injured by microwave radiation. Of course, every one of them was a potential legal case, and it is to the credit of the companies that they continued to send those cases, for I made it clear to begin with that I would disclose my findings to each patient, and I requested that I be per-

mitted to perform follow-up examinations. It turned out, what I found ultimately changed my whole thinking about microwave cataractogenesis, for slit-lamp examination revealed not only that all six of these patients had developing cataracts but also that the cataracts were forming on the posterior capsular surface. This was a totally unexpected finding—the possibility of such damage had not even been included in the parameters of the survey I was conducting for the Air Force. Naturally, I began looking for similar abnormalities in the people who had been selected for the official survey, and I soon began to find them. In one group of forty-odd radar trouble-shooters from a large electronics company, I found that fully one-third of them had roughening and thickening of the posterior capsular surface—a kind of pre-cataractous scarring that I later came to realize was an early sign of microwave injury."

When Zaret wrote his final report for the Air Force survey, in March of 1963, he knew that the criteria upon which the study had been based—the occurrence of imperfections within the lens—were not a valid method of assessing the ophthalmological hazard posed by microwaves. Within a year, however, thanks largely to the cases he had seen in private consultation, he believed that he had found a way to make this assessment. "I knew by then that the typical microwave cataract tends to involve the posterior surface of the lens, whereas the typical infrared or heat cataract involves the front surface," he has said. "This occurs for two reasons: first, because microwave radiation penetrates deeply and heats the whole eye; second, because the iris, with its greater blood circulation, keeps the front portion of the eye cooler than the rear portion. For these reasons, I suspected not only that microwave injury leading to cataract formation tended to occur first at the posterior capsule but also that posterior capsular cataract was a marker disease for exposure to microwaves. Therefore, I was prepared to make a presumptive diagnosis of microwave cataracts as a clinical entity on the basis that posterior capsular opacification could serve as the special signature of microwave injury. This, in turn, enabled me to start looking for pre-cataractous changes in workers who were being exposed to microwave radiation, and to recommend preventive measures where indicated."

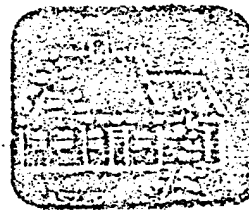
In October of 1964, Dr. Zaret published his findings on three cases of posterior capsular cataracts. The data appeared in the final report of a year-long

study he... Declassified and Approved For Release 2012/05/10 : CIA-RDP88B01125R000300120113-6
Force in order to arrive at a new methodology for assessing the cataractogenic effects of microwave radiation. However, the Air Force was apparently unimpressed by the information, for in the same report it announced the termination of its microwave-eye-study program and of any follow-up research. "By this time, I was beginning to wonder about the military's attitude toward the problem of microwave exposure," Zaret said. "Here I had spent three years examining nearly sixteen hundred microwave workers, and except for one case that didn't count, because diabetes was involved, I hadn't come across a single cataract. Then, right in the middle of my survey, some of the very firms that were taking part in it began sending me patients on the side—patients who had been diagnosed as having cataracts. Why weren't such patients included in the official survey? Why did they all come from private companies? Why had I not seen any cataracts among military personnel? Had I been examining a true cross-section of people exposed to microwave radiation? Or was something funny going on in the selection process, because of worries over public disclosure and possible legal problems?"

Zaret soon had other reasons to consider the possibility that exposure to microwaves was being viewed in a non-medical manner. "By this time, I had been approached on a number of occasions by the Central Intelligence Agency," he says. "The contacts were innocuous to begin with. At first, the C.I.A. people wanted to know about research I had performed on the ophthalmological effects of microwave and laser radiation. They also wanted me to analyze some of the foreign and American literature on the subject of radiation for them. In 1964, however, they started asking me about the possible behavioral effects of microwaves. They wanted to know, for example, whether I thought that electromagnetic radiation beamed at the brain from a distance could affect the way a person might act. I said that from what I had read primarily in Soviet literature on the subject it seemed conceivable. During 1964 and 1965, I had a number of visits from a medical doctor who worked for the agency. He wanted to know if a device that took pictures at night with an invisible laser beam instead of a conventional flashbulb was safe to use. When I exposed the eye of a rabbit to the beam, I found that it produced an immediate retinal hemorrhage, so I told him that in my opinion the device was not safe. He also wanted

beam directed at a listening device planted on a window will be liable to injure anyone inside the room that was being bugged? And could microwaves be used to facilitate brainwashing or to break down prisoners under interrogation?"

Early in 1965, Dr. Zaret was informed by his C.I.A. contact that the Russians had been irradiating—or zapping, as the popular saying goes—the American Embassy in Moscow with microwaves. "The C.I.A. people seemed puzzled and confused by this development," Zaret recalled recently. "Later that year, they invited me to attend a special meeting on the subject at the Institute for Defense Analyses, in Arlington, Virginia, where I met a number of people from the Defense Department's Advanced Research Projects Agency, who were also working on the problem. There appeared to be considerable anxiety in the minds of some of these people over whether the Moscow Signal, as it was called, was a serious attempt to actually alter the behavior of our personnel at the Embassy. This anxiety no doubt resulted from the fact that the signal, which was described in detailed technical terms at the meeting, was not considered to be suitable either for electronic eavesdropping or for jamming electronic listening devices. It was being generated at multiple frequencies and widely fluctuating patterns, and at power densities that never exceeded four milliwatts per square centimetre. Since the Russians considered radiation at this level to be unsafe, and since we had only very limited data on the question, I advised the Department of Defense people to irradiate monkeys with a signal of the same frequency and power density, in order to determine what the signal's behavioral and biological effects upon human beings might be. I told them that in my opinion our government ought to demand that the Russians stop irradiating the Embassy at once. I also told them that thorough medical examinations of the Embassy staff members should be performed, and that these people should be informed of what had been done to them. Subsequently, some associates and I conducted research for the Advanced Research Projects Agency by replicating a few selected Soviet and Eastern European behavioral experiments on rats and rabbits. We performed this research with the help and



assistance of Professor Saul W. Rosten, the Department of Electrical Engineering and Electrophysics of the Polytechnic Institute of New York. In some cases, we were able to confirm the Soviet and Eastern European results and in others we were not. I remember that on one occasion we not only succeeded in replicating a Czechoslovak study of behavioral effects in rats but also observed some unique convulsions in these animals prior to death. When I relayed that information to Washington, I received a telegram from the agency ordering me not to pursue the investigation any further.

Later, I was given to understand that, as part of a highly classified operation called Project Pandora, tests to determine the effects of the Moscow Signal were conducted at the Walter Reed Army Institute of Research, in Washington, D.C., and that some deficiencies in the animals' ability to function and to perform tasks were observed. However, I was never told officially of the results of any of these studies."

Meanwhile, Zaret had continued to spend most of his time investigating the effects of microwave radiation upon the eye. In 1963, he had set up his own research foundation to facilitate these efforts, and in 1964, after the Air Force terminated its eye-study program, he undertook for the Army a study of military and civilian personnel who had been exposed to microwaves, in order to look for early signs predictive of eye injury. He also continued to examine patients who were referred to him by industry for private consultation. At that time, only five documented cases of human microwave cataracts were known to exist. Over the next five years, however, Zaret found thirty-nine more cases of incipient or clinically significant 'microwave cataracts. "All thirty-nine cases occurred in men who worked for the Army, the Navy, the Air Force, the National Aeronautics and Space Administration, and in the electronics industry," Zaret said. "Most of the men were engaged in the research and development or the testing and maintenance of high-power radar systems. They averaged about forty years of age, which meant that they were far too young for naturally occurring cataracts, and none of them were known to have any hereditary or pathological predisposition toward the disease. Most important of all, slit-lamp examination showed that each of these

By the end of the decade, Zaret had collected and published data on a total of forty-two cases of microwave cataracts, and he also claimed to have found nearly two hundred cases of roughening and thickening of the posterior capsular surface, which he considered to be early evidence of cataract development. He had also lost the contract with the Army for the prospective study. "The Army decided not to renew the contract in 1968, shortly after I reported posterior capsular changes in seven civilian employees at the Signal Corps base at Fort Monmouth, New Jersey," he said dryly. "The chief of Ophthalmology Service at the Walter Reed General Hospital, Colonel Budd Appleton, told me there was no such thing as a microwave cataract. He claimed the only thing one could say was that a patient had a developing cataract due to normal aging. One trouble with this theory was that in many of the forty-two cases I had reported, a cataract had formed in only one eye, whereas senile cataracts usually develop bilaterally. Of course, the military people were anxious about my findings for a number of reasons. First of all, if I turned out to be correct, and if it became widely recognized and accepted that microwaves could cause a specific and recognizable type of cataract, the armed forces were liable to incur some huge medical-legal problems, especially with civilian employees who had been exposed to radar. Second, and even more important, an enormous part of the nation's weapons-development program for the next decade, including the anti-ballistic-missile systems, was predicated on the assumption that the ten-milliwatt level was safe. If this standard turned out to be unsafe and had to be lowered, the cost of relocating radar and missile sites and of redesigning equipment would amount to billions of dollars.

With so much at stake in the ten-milliwatt standard, the military could scarcely afford to accept any findings that cast doubt on the theory that cataract formation was thermal in origin. But, you see, like the two technicians in Thule, none of my forty-two patients had any recollection whatsoever of experiencing heat or pain in their eyes. This meant that cataracts could be produced by exposure to microwave levels that did not produce acute burn, which, in turn, raised the possibility that cataracts might form in the eyes of people who were chronically exposed to low levels of microwave radiation over long

periods—for example, radar technicians who worked in microwave ovens that leak."

FROM this point on, Zaret found himself engaged in a running battle with the military over whether microwaves were responsible for the development of cataracts in the eyes of men who had been exposed to radar. The situation was exacerbated by the fact that a number of ex-servicemen who had worked as maintenance technicians on radar picket planes during the nineteen-fifties and nineteen-sixties and had lost their sight as a result of cataract formation had filed disability claims with the Veterans Administration and had also initiated lawsuits against the manufacturers of the equipment they had used. Since there was no conclusive proof of what level of microwave radiation constituted a hazard to the human eye, the military, viewing such claims, together with Zaret's findings, as a threat to the ten-milliwatt level, proceeded to gather statistics and opinions to counter them. Ophthalmologists working for the Army and the Air Force conducted eye surveys showing that lens imperfections and cataracts were not occurring any more frequently in personnel exposed to radar than in personnel who had no exposure. Furthermore, they were unanimous in the opinion that cataracts occurring in the eyes of former radar technicians were no different from those occurring in the eyes of people who had no exposure to radar. They concluded, therefore, that the probability of cataracts' being caused by microwave radiation was low unless a specific instance of severe exposure



could be documented and correlated with subsequent cataract development, and that the ten-milliwatt level was safe. Since Zaret stood alone in his contention that exposure to microwaves could cause unique changes in the posterior capsule, proof of a specific microwave cataract was considered lacking, and, with one exception, the disability claims of the former radar technicians were disallowed by the Veterans Administration.

As it turned out, the exception was one of Zaret's early patients—a man named Arthur Kay, who had served as a radar trouble-shooter on Navy radar picket planes during the Korean war, and who later developed a cataract. Kay's original claim for disability had been turned down by the V.A. in 1969. However, with Zaret's help he was subsequently able to furnish infor-

waves, and in 1972, after a V.A. appeal hearing at which Zaret appeared as his principal witness, Kay won his case. Kay's cause was also aided by Dr. Shields Warren, professor emeritus of pathology at the Harvard Medical School, who had been brought in as an independent consultant by the Board of Veterans Appeals, and who gave the opinion that Kay's cataracts had indeed been caused by microwave radiation. As for the Navy's contention that Kay and other crew members of radar picket planes had not been exposed to microwaves, its falseness was revealed by the Navy at its nineteenth annual Occupational Health Workshop, which was held in Charleston, South Carolina, in September of this year. At that time, the officer in charge of the Radiation Health Branch of the Navy Environmental Health Center, in Cincinnati, stated that he and some assistants had recently measured the power density of microwave radiation emanating from the radar-antenna dome ten feet aft of the flight-crew ladder on the belly of an old P-2 Lockheed Neptune radar picket plane, and, finding it to be between three and five hundred milliwatts per square centimetre from a distance of ten yards, they guessed that it would be about six hundred milliwatts per square centimetre up close. He further stated that anyone climbing the flight-crew ladder leading into the aircraft could have been exposed to these high intensities.

Back in 1971, however, the Navy, which may well have come to the conclusion that it had embarked on a collision course with Zaret, decided not to renew a contract it had awarded him to study the delayed effects of chronic microwave exposure on primates under conditions simulating human exposure. When Zaret asked for an impartial hearing on the matter, the Navy convened a five-man ad-hoc committee, which, after holding a meeting at the New York City headquarters of the Rand Corporation, upheld the decision to terminate Zaret's contract. The members of this committee included William A. Mills, director of the Environmental Protection Agency's Twinbrook Research Laboratory, in Rockville, Maryland; Dr. David D. Donaldson, an ophthalmologist at the Massachusetts Eye and Ear Infirmary, who, as a member of the military's Joint Services Committee on Microwave Ocular Effects, had examined the eyes of former Air Force radar workers; Professor Sol M. Michaelson, of the Department of Radiation Biol-

Dentistry, who was a leading consultant on microwave radiation to the Association of Home Appliance Manufacturers; John M. Osepchuk, a consulting scientist with the Raytheon Company, the world's leading manufacturer of microwave ovens; and Samuel Koslov, who was then a research scientist with the Rand Corporation and a member of the federal Electromagnetic Radiation Management Advisory Council, who had previously participated in Project Pandora as an official in the Department of Defense, and who has since become special assistant for research to the Assistant Secretary of the Navy.

The fact that representatives of the microwave-oven industry had agreed with the military in opposing Zaret was not surprising, for two reasons. In the first place, Raytheon and other microwave-oven manufacturers also made (and still make) radar and missile-guidance systems. And, in the second, the microwave-oven industry was in the midst of an enormous expansion that would be jeopardized if Zaret's theories about the low-level cumulative effects of microwaves proved to be correct. After the passage of the Radiation Control for Health and Safety Act of 1968, the manufacturers of microwave ovens had undertaken to make technical improvements in their products to keep them from leaking radiation in excess of the ten-milliwatt level, which had been voluntarily adopted by the Association of Home Appliance Manufacturers. However, in 1969 a four-state survey of microwave ovens by the Environmental Control Administration's Bureau of Radiological Health showed that a third of them failed to meet this limit, and in 1970 a government-industry survey of nearly five thousand ovens revealed that ten per cent were exceeding the voluntary standard. The survey indicated that faulty door seals and faulty safety interlocks—devices that are supposed to turn the oven off when the door is opened—were the chief causes of leakage, and that improper servicing and maintenance as well as normal wear and tear were also factors. No one knew just how many microwave ovens were in use in this country, but estimates for 1969 ranged anywhere from one hundred thousand to two hundred thousand, so the Bureau of Radiological Health was sufficiently concerned about the situation to recommend that until ovens could be tested for leakage consumers ought to remain at least an arm's length away from them while

they were in operation, and that children should not be allowed to watch food cooking through the oven doors. As for the microwave-oven manufacturers, they claimed that their products were not leaking radiation at levels that had been proved harmful; that a person being irradiated with unsafe levels of microwave radiation would always be able to feel heat in time to move out of danger; and that the biological effects of microwaves were not cumulative. Nevertheless, when the Bureau of Radiological Health people got around to promulgating a performance standard for microwave ovens, in October of 1970, they decreed that as of October 6, 1971, no oven prior to sale should leak radiation exceeding one milliwatt per square centimetre at a distance of five centimetres from its surface, and that no oven after purchase should leak more than five milliwatts over the same distance.

No one knows on what scientific basis, if any, the bureau determined that a five-milliwatt emission standard for microwave ovens would be safe for consumers, let alone how it expected any housewife to ascertain the amount of radiation leaking from a particular oven. It is known, however, that during 1969 and 1970 the bureau carefully studied and documented a case attributing the formation of what it called "typical microwave-radiation cataracts" to levels of exposure that cast doubt upon the safety of the new standard. The case involved a thirty-eight-year-old radiation-safety officer from New Mexico, who between June and December of 1968 had undergone a series of twelve fifteen-

minute microwave-diathermy treatments for painfully sprained neck muscles. The diathermy machine with which the patient was treated generated microwave radiation at a frequency of twenty-four hundred and forty megahertz, which also happens to be within the operating-frequency band of the vast majority of microwave ovens that are manufactured and used in the United States. During the winter of 1969, vision in the patient's right eye became hazy; in May, vision in his left eye began to deteriorate; and in July he was diagnosed as having bilateral posterior subcapsular cataracts. This diagnosis was subsequently confirmed by Dr. Donaldson, of the Massachusetts Eye and Ear Infirmary, and by Professor Russell L. Carpenter, a zoologist who had recently retired from the Department of Biology of Tufts University and had become a consultant to the bureau's Northeastern Radiological Health Laboratory, in Winchester, Massachusetts. After extensive investigation, Donaldson and Carpenter ruled out the possibility that their patient's cataracts could have been caused by diabetes, senility, chronic uveitis, or exposure to cortisone steroids or X-rays. Carpenter then set out to reconstruct the radiation pattern and power levels of the microwave field to which the patient had been exposed—something it had rarely been possible to ascertain with any real accuracy in the case of radar technicians, who usually worked with equipment generating microwaves of different wavelengths and power densities. With the cooperation of the patient and the physician who had given the diathermy treat-

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 patient's right eye had been exposed to approximately thirty-three milliwatts per square centimetre and his left eye to only about two milliwatts per square centimetre. This was an astonishing finding, and, not surprisingly, the case received prominent mention in the bureau's 1969 annual report to Congress. When Carpenter described it at the fifth annual symposium of the International Microwave Power Institute, which was held in Scheveningen, in the Netherlands, on October 7, 1970, he stated that it provided a "unique example of bilateral cataracts resulting from low-level microwave radiation." Strangely, Carpenter's statement came one day after the bureau announced the promulgation of its five-milliwatt emission standard for microwave ovens. Equally strange is the fact that neither he nor Donaldson ever saw fit to submit their findings for official publication. The case never became part of the medical literature, and it has been virtually forgotten. Indeed, both Carpenter and Donaldson have since written that they knew of no case of cataracts that could be definitely attributed to microwave radiation.

During 1971 and 1972, the controversy over the biological effects of microwaves, which had previously been carried on in scientific and military circles, received considerable public attention, thanks to a series of articles written by the syndicated columnist Jack Anderson which appeared in newspapers from one end of the country to the other. Anderson began by describing the plight of a group of retired Air Force radar technicians who had developed cataracts after serving as crewmen on Lockheed Constellation EC-121 spy planes, and by questioning the claim of the Air Force that the levels of microwave radiation to which these men had been exposed presented no hazard to their eyes. He went on to say that in 1969 the Air Force had transferred the physician in charge of radiobiology at its Aerospace Medical Division after he had stated publicly that microwave radiation presented a serious hazard to the eyes of servicemen exposed to radar and other microwave devices and that thorough investiga-

the Navy to task for terminating its financial support of Zaret's study of the chronic effects of microwaves upon monkeys, and suggested that Zaret's preliminary report that some monkeys had died after being exposed to relatively low levels of radiation might have had something to do with it. (Zaret had informed the Navy in February of 1970 that one monkey had died after being irradiated for several hours with only twenty milliwatts per square centimetre, and that "the finding has extremely serious implications.") In subsequent columns, Anderson expressed doubts about the safety of microwave ovens, and in May of 1972 he broke the ten-year-old story of how the Russians had beamed microwave radiation into the American Embassy in Moscow in the early nineteen-sixties. In his account of the Moscow incident, Anderson revealed that the whole affair had been kept secret from employees at the Embassy; that the C.I.A. had speculated that the Russians might be trying to brainwash American diplomats; and that scientists working for the Advanced Research Projects Agency had attempted to come to grips with the mystery by irradiating monkeys and other test animals in a secret study called Project Pandora, whose results were said to have been inconclusive.

representatives of both the military and industry, who maintained that many of his assertions concerning the hazards of radar and microwave ovens were either inaccurate or unnecessarily alarming. Curiously, no one in the military or in industry attempted to refute his claim that the Russians had tried to alter the minds and behavior of American Embassy personnel in Moscow with microwave radiation, and in August the Russians themselves lent credence to Anderson's claim by voicing a suspicion, during the chess matches in Reykjavik, Iceland, that aides of Bobby Fischer were irradiating Boris Spassky with electronic devices in an effort to cause the Russian master to lose his championship. Be that as it may, back in December of 1971 the nine members of the Electromagnetic Radiation Management Advisory Council—a group that had been established three years earlier by the President's Office of Telecommunications Policy—had released a little-publicized report assessing the possible biological hazards of microwaves and other radio-frequency energy in terms that made Anderson's revelations seem fragmentary, if not tame, by comparison. Among other things, the council's report pointed out that microwave radiation was permeating the modern environment; that such man-made radiation had no counterpart in man's evolutionary background; that existing levels of radio-frequency energy might already be biologically significant; and that the consequences of undervaluing or misjudging the biological effects of long-term, low-level exposure could become a critical public-health problem—especially if genetic effects were involved. Having hinted at the unthinkable in its overall evaluation of the problem, the council proceeded to recommend ways of solving it which promised to continue a business-as-usual approach to the situation. In its "Program for Control of Electromagnetic Pollution of the Environment," which was adopted by the government, the council did not propose a single measure for controlling microwave radiation. Instead, it called for a coordinated five-year, multi-agency, sixty-three-million-dollar research effort to determine whether microwave

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radiation. Declassified and Approved For Release 2012/05/10 : CIA-RDP88B01125R000300120113-6

Moreover, the council delegated primary responsibility for determining the effects of long-term low-level microwave radiation to the Department of Defense, which for twenty-five years had been not only trying to deny that any such hazards might exist but casting a pall of obfuscation over the entire question in much the same way that metallic chaff was dropped from airplanes during the Second World War to create false echoes and blur the enemy's radar.

THE publicity generated by the microwave controversy in 1971 and 1972 was bound to have political repercussions, and on March 8, 1973, the Senate's Committee on Commerce opened three days of hearings to determine how the Radiation Control for Health and Safety Act of 1968 (Public Law 90-602) had functioned since its passage. The committee's presiding officer, Senator John V. Tunney, of California, said in his opening statement, "Unfortunately, preliminary work by the committee has raised some disturbing questions about radiation safety in this country, and calls into question whether Public Law 90-602 has in fact resulted in big enough steps being taken to insure that long-term and far-reaching radiation damage will be avoided." Senator Tunney went on to say that a major source of concern to the committee was the increasing proliferation of devices emitting microwaves into the environment; that industry would soon be selling two hundred thousand microwave ovens a year; and that "only yesterday the Consumers Union recommended against the purchase of any microwave oven, primarily because of the unknown biological effects of microwaves." Senator Tunney was referring to an announcement that Consumers Union had obviously issued to coincide with the opening of the hearings, and that was being carried in newspapers across the country. In its announcement, Consumers Union stated that it had found measurable radiation leakage in fifteen leading microwave-oven models; that it considered the government's five-milliwatt emission standard inadequate, because there were no data on what quantity of low-level radiation could cause human injury; that although the leakage it had detected was within the five-milliwatt level, a tug on the door of one model and a paper towel caught in the door of another caused leakage far in excess of the government standard; and that it felt the burden of proof was therefore

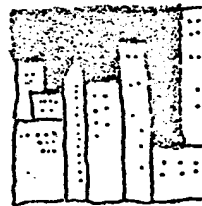
The first witness at the hearings was John C. Villforth, director of the Bureau of Radiological Health, who praised the government's microwave-research program and defended the five-milliwatt emission standard for microwave ovens, saying, "Although reliable human data [are] not yet available, we do have animal experiments and epidemiological studies to give us confidence that the limit that we have set is reasonable." Villforth subsequently referred questions about the testing of microwave ovens to Dr. Robert L. Elder, deputy director of the bureau and a former director of its Division of Electronic Products, who also defended the five-milliwatt level as valid in terms of the available biological information. Senator Tunney then asked Dr. Elder, "If low-level effects are unknown, why not err on the side of safety—particularly when research that has been done on low-level exposure by the Russians and other researchers in this country, such as Dr. Milton Zaret, demonstrate that it could be injurious to health?" Elder said he believed that in setting up its testing procedures the bureau had erred on the side of safety to begin with. Something he did not mention was that less than a year before, as a member of the American National Standards Institute's subcommittee on radio-frequency hazards, he had recommended that the microwave-protection guide be lowered to one milliwatt per square centimetre.

On the following day, Dr. Clay T. Whitehead, director of the Office of Telecommunications Policy, told the committee that his office was attempting to coordinate studies in the research program recommended by the Electromagnetic Radiation Management Advisory Council, which were being carried out by the Department of Defense together with a dozen different agencies and subagencies. When Senator Tunney asked him if he was satisfied that adequate protection was being given to consumers, and particularly to housewives using microwave ovens, Dr. Whitehead replied that although he was not an expert in the field, he was convinced that "the standards that we have now are appropriate to the kinds of hazards that we can document through scientific study." Senator Tunney then recalled that in a press release announcing the government's research program Dr. Whitehead had stated that the potential impact of microwave radiation on human beings was unknown, and that the probable effects of

low-level exposure to low levels of radiation were not known. "If this is true," Senator Tunney asked Dr. Whitehead, "wouldn't you agree with the Consumers Union that it would be unwise to expose yourself to any unneeded radiation until more is known?"

"No one should expose himself to any unneeded radiation," Dr. Whitehead replied. "The problem is that so much of the radiation that people are exposed to—microwave ovens, television transmitters, and what have you—are all devices that are doing very useful things that people want to do and want done for them. I think the important thing to recognize is that there is no evidence that there is a hazard from low-level energy radiations. It's just that there is some uncertainty in the scientific knowledge, and that we can't rest on our laurels."

The next witness to appear before the committee was Dr. Zaret, who stated at the outset that in his opinion there was a "clear, present, and ever-increasing danger" to the entire population of the United States from exposure to the non-ionizing portion of the electromagnetic spectrum. "The dangers cannot be overstated," Zaret said, "because most non-ionizing radiational injuries occur covertly, usually do not become manifest until after latent periods of years, and when they do become manifest, the effects are seldom recognized." Zaret went on to characterize the ten-milliwatt level recommended by the American National Standards Institute's subcommittee on radio-frequency hazards—an organization from which he had recently resigned—as being patently unsafe, and to blame the Department of Defense for leading the country astray by minimizing the true extent of the microwave-radiation hazard. He was particularly critical of the ethics and the safety of a study being conducted at the Naval Aerospace Medical Research Laboratory, in Pensacola, Florida, in which human volunteers were being exposed to radio waves in the extremely-low-frequency portion, or ELF, of the electromagnetic spectrum. This study had been undertaken to assess the possible biological hazards of Project Sanguine, an ambitious scheme—later renamed Project Seafarer—that would bury a gigantic, three-to-four-thousand-square-mile underground radio-antenna system three to six feet below ground in the Upper Peninsula of Michigan, in order to permeate the entire biosphere with extremely-low-frequency



the Navy to communicate with deeply
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reservations about the study were subsequently confirmed in part by the fact that blood-serum triglyceride levels rose to abnormally high levels in nine out of ten volunteers following one day of exposure to an extremely-low-frequency magnetic field, and also by the fact that in another study of eleven men exposed to the field there was a significant decline in their ability to perform simple addition. (These results were not made public by the Navy for more than two years, but the Navy ended the human volunteer study, and is now conducting an extensive study of the chronic exposure of monkeys to extremely-low-frequency electromagnetic fields.) Zaret's reservations about Project Seafarer as a whole have also been confirmed in part by the revelation that Soviet workers in high-voltage switchyards, who have been occupationally exposed to electric and magnetic fields at extremely low frequencies similar to those employed in Project Seafarer, have experienced instability in pulse and blood pressure, slowed heartbeat, anemia, tremors in the arms and legs, and diminished sexual vigor. Zaret has since hypothesized that extremely-low-frequency electric fields from sources such as high-voltage power lines might prove to be a partial causative factor in sudden-infant-death syndrome. As for the residents of the Upper Peninsula,

about the nation's taxpayers about a hundred million dollars, by voting against it in special referenda held last spring during the Michigan primary elections. Political opposition on the part of the inhabitants of northern Wisconsin and Texas had previously defeated efforts by the Navy to locate the project in those areas.

At the conclusion of his testimony in the 1973 hearings, Zaret told the committee that he had recently observed typical microwave-radiation cataracts in the eyes of a housewife whose only known exposure to microwaves had come from the use of a microwave oven that leaked. "The sun is our strongest natural source of microwaves," Zaret continued. "The microwave-oven-leakage standard set by the Bureau of Radiological Health is approximately one billion times higher than the total, entire microwave spectrum given off by the sun. It is appalling for these ovens to be permitted to leak at all, let alone for the oven advertisements to encourage our children to have fun by learning to cook with them."

Zaret was followed to the witness table by John Osepchuk, of Raytheon, who was accompanied by Professor Michaelson, of the University of Rochester. After announcing that he and Michaelson were appearing on behalf of the Association of Home Appliance

that he the safety of microwave ovens in perspective by quoting Dr. James A. Van Allen, professor of physics at the University of Iowa, who had described the hazards of microwave ovens as being "about the same as the likelihood of getting a skin tan from moonlight." Osepchuk went on to say that the five-milliwatt emission standard provided a high degree of safety; that in an estimated total of a hundred million hours of microwave-oven use over the past twenty years there had been no validated report of injury to any consumer because of microwave exposure; that there was no scientific basis for believing that cumulative molecular damage could be caused by microwaves; and that the only known possible hazard associated with microwaves resulted from heat.

Osepchuk concluded his testimony by stating that both the scientific and the popular literature contained a great deal of misinformation and nonsense about microwaves, and then he introduced Professor Michaelson, who told the committee not only that there was no substantial evidence of injury to human beings as a result of exposure to microwave radiation within the ten-milliwatt level but also that the scientific and medical communities had not been able to produce any substantial evidence of injury below the level of a hundred milliwatts per square centimetre. Michaelson went on to say that the concept of cumulative effects was based on flimsy evidence; that the Soviet data concerning effects of low-level microwaves upon the central nervous system were questionable; and that current standards were entirely adequate to protect the public health. "In closing, I would like to make a plea," Michaelson said. "We have reached the point now where we cannot continue to succumb to self-interest groups and individuals who fail to substantiate their claims."

When Michaelson had completed his statement, Senator Tunney quoted a passage from an article entitled "Biologic Effects of Microwave Exposure," which Michaelson and some associates had published in a United States Air Force technical report in 1967 concerning the studies undertaken by the Russians. The passage read:

The occasional reports of headache, lassitude, stomach-ache pains, sleeplessness, irritability.

microwave generating equipment have not been thoroughly investigated. These findings should not be ignored, as similar vague, mild, and undefined symptoms have been experienced in the course of microwave studies in this laboratory. Such symptoms do indicate a basic microwave effect.

When Senator Tunney had finished reading this passage, he observed that after listening to Professor Michaelson's testimony he felt that the professor had changed his mind since writing the article, and asked if this was so.

Michaelson replied that he had indeed changed his mind, and then he explained why. "I have written extensively since then and I have been very fortunate in having had the opportunity to read, study, and survey the literature extensively and intensively in the last several years," said Michaelson, who is a member of the National Academy of Science's Committee on Biosphere Effects of Extremely-Low-Frequency Radiation, which has been set up to determine whether the Navy's proposed Seafarer communications system might prove harmful to human beings, animals, plants, and other organisms. "I have also been very fortunate to be affiliated with many organizations in which these problems are being discussed, and I have been able to critically analyze many, many of the problems, and I feel very secure; in fact, I feel much more confident now than I appear to have been in 1967."

Professor Michaelson was the last witness to testify about the biological effects of microwaves, and when he had finished, Senator Tunney confessed that he was puzzled. "I am somewhat confused by the difference in the testimony that we have had in the past two days, and this is something that I'll have to resolve myself through further study," he said. "I think a person who is not completely familiar with the field would have to agree with me that, in listening to the statements that have been made, there is, in some instances, a one-hundred-and-eighty-degree difference in approach, and I therefore feel that I personally am going to have to do more research and talk to more people who are recognized experts."

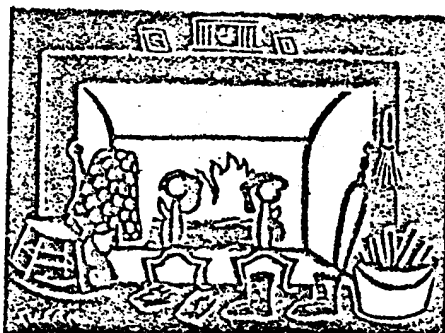
IF Senator Tunney had attended the four-day International Symposium on the Biologic Effects and Health Hazards of Microwave Radiation, which was co-sponsored by the governments of Poland and the United States and by the World Health Organization, and was held at Jadwisin, near Warsaw, in October of 1973, he

recognized experts from twelve nations, who had met to exchange information and ideas about the microwave problem. He would also have seen some familiar faces. It seems highly unlikely, however, that he would have been able to resolve the confusion he had felt seven months earlier as a result of the conflicting testimony given at the hearings. On the one hand, the Senator would have heard John Villforth, director of the Bureau of Radiological Health, state that his organization had "only scratched the surface in developing a biological-effects program with respect to microwaves," and that "even this minimal effort is only being directed at the frequency which is utilized for microwave cooking and for which instrumentation is available." On the other hand, he would have heard Professor Zinaida V. Gordon, director of the Laboratory of Electromagnetic Fields at the Institute of Industrial Hygiene and Occupational Diseases of the U.S.S.R. Academy of Medical Sciences, and a widely respected pioneer in microwave research, say that she and other Soviet investigators had been conducting extensive hygienic, clinical, and experimental studies of the whole range of radio frequencies for more than twenty years, and that there was absolutely no doubt that microwave radiation could have biological effects at intensities far below those necessary for the heating of tissue.

With regard to one-hundred-and-eighty-degree differences of approach, Senator Tunney would have learned that American researchers, in keeping with their long tradition of studying primarily the thermal effects of large microwave exposures, had produced fetal deaths and serious birth defects by irradiating pregnant mice with single two-to-five-minute doses of a hundred and twenty-three milliwatts per square centimetre, whereas their Soviet counterparts had obtained similar results by irradiating pregnant mice with daily two-hour doses of only six and a half milliwatts. Concerning the development of cataracts, he could have chosen between a paper submitted by Pro-

biological Health, who wrote, "As now, we do not know of a case which microwave radiation has been a proven cause of a human cataract and one delivered by Dr. Zaret, who declared that he knew of more than fifty cases with prima-facie evidence of cataracts caused by microwave radiation. And concerning the cumulative effects of microwave radiation in producing cataracts—a concept that was first suggested fifty years ago, by Sir Stewart Duke-Elder, of the Institute of Ophthalmology in London, and was later demonstrated in animal experiments by Professor Carpenter—he could have taken his pick of a number of conflicting opinions. Doubts about the validity of the theory were voiced by Michaelson and by Colonel Budd Appleton, of Walter Reed, whereas it was defended by Dr. Morris L. Shore, who is director of the Division of Biologic Effects of the Bureau of Radiological Health, and by Dr. H. D. Baillie, a surgeon at the Royal Infirmary of the University of Manchester, who observed that if microwaves produce injury to tissue, one cannot assume that the injury disappears when the power is turned off. And, if he had managed to remain unconfused through all this, Senator Tunney could have picked up some interesting historical tidbits concerning microwaves. He would have learned, for example, that during the Second World War the Japanese Army had investigated the use of microwave radiation as a death ray but that the results of the studies had been destroyed by fire in 1945.

Perhaps the most significant paper at the symposium was delivered by Dr. Maria N. Sadčikova, a senior research worker at the Soviet Union's Institute of Labor Hygiene and Occupational Diseases, who furnished evidence to support the long-held Soviet contention that microwave sickness was a distinct form of occupational disease. Dr. Sadčikova presented detailed clinical observations of the health status of two groups of workers who had been engaged in the regulation, tuning, and testing of microwave-generating equipment of various sorts. The first group consisted of a thousand workers who had been exposed to power densities of up to a few milliwatts per square centimetre, and the second of a hundred and eighty workers whose exposure had as a rule not exceeded several hundredths of a milliwatt. Both groups consisted mostly of men under forty who had worked with microwaves for periods ranging from five to fifteen



years. When Sadčikova compared the health experience of these two groups with that of a control group of two hundred people whose work did not involve exposure to microwaves, she found that among the microwave workers there was a significant increase in neurological complaints, such as heaviness in the head, fatigue, irritability, anxiety, insomnia, and partial loss of memory. In addition, she found that the microwave workers showed a significant increase in cardiovascular symptoms, such as a tendency to have slow heartbeat, reduced blood pressure, and reduced ventricular capacity, and that many of them complained of piercing heart pains that spread to their shoulder blades and their arms. While Dr. Sadčikova did not observe serious cardiovascular malfunction or irreversible neurological changes among the microwave workers, she clearly substantiated the findings of previous Soviet investigations, which had shown that the clinical picture of microwave sickness was characterized by a complex of nervous-system symptoms and of vascular disturbances, including crises of cerebral and coronary insufficiency. She was also able to determine that neurological complaints usually occurred in the initial stages of microwave sickness; that cardiovascular symptoms manifested themselves in the more advanced stages of the disease; and that the symptoms increased in severity and the malady tended to pro-

gress in workers whose exposure to microwaves continued, whereas in workers whose exposure ceased altogether the disease was frequently stabilized.

The fact that the workers studied by Sadčikova had been exposed to microwave intensities far below the ten-milliwatt level that had long been considered a safe standard of exposure in the United States for both workers and members of the general population could not have been lost on the American scientists who attended the symposium in Poland. However, except for Zaret, who was considered by many scientists to be a maverick and an alarmist, no American researcher had come right out and said that microwave radiation would prove to be a health hazard for the general population—this despite the fact that investigations conducted both in the United States and in the Soviet Union had clearly shown that intensities of electromagnetic radiation were much higher in the vicinity of television transmitters, television-relay links, and radar stations than elsewhere, and that these intensities might be biologically significant. On the last day of the symposium, however, the possibility that a public-health hazard already existed was raised in bizarre fashion by Zaret, who had also evolved an unusual theory about the effects of non-ionizing radiation upon the heart.

For nearly ten years, Zaret had observed that many of his ophthalmological patients who had worked either

with radar or with other microwave-generating equipment were developing cardiovascular disease at an early age. Since studies all over the world indicated that cardiovascular disease is multifactored, and since he was aware of Soviet studies concerning the cardiac effects of microwaves, Zaret wondered if exposure to microwave radiation could be contributing to the occurrence of heart disease in his patients. He attempted to explain how this might happen in an article entitled "Clinical Aspects of Non-Ionizing Radiation," which appeared in the July, 1972, issue of the *Transactions on Biomedical Engineering*, a journal published by the Institute of Electrical and Electronics Engineers. Zaret offered a rationale of how low-intensity microwave radiation could cause cataracts to form on the lens capsule of the eye. "As the eye focusses during vision, the elastic lens capsule is constantly under the stress of relative stretch and relaxation," he wrote. "Normally after each stress from stretching there is complete recovery. However, following excessive irradiation, the elastic properties of the capsule may be altered. Eventually this would lead to a mechanical fatigue of the membrane."

After theorizing that structural fatigue of the lens capsule could, in turn, lead to changes in its composition and thus to the development of cataracts, Zaret suggested that elastic-membrane fatigue might also provide a rationale

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radiation on other organs. He wrote:

For example, currently there is no acceptable explanation for the delayed cardiac effects occasionally seen following non-ionizing radiation exposure. However, the linings of the heart and its major blood vessels are contained within an internal elastic membrane. The cardiovascular elastic membrane, like the lens capsule elastic membrane, is constantly under the stress of relative stretch and relaxation as it helps to sustain the hydraulic pressure of the circulatory system. Here again, after each stress from stretching there is complete recovery. However, following excessive irradiation, the elasticity of this membrane could also eventually undergo mechanical fatigue and this would ultimately lead to degradation of the elastic membrane's integrity and result in cardiovascular disease. There is much to support this concept because one of the best-known delayed appearing radiation effects is premature aging, which occurs concomitantly with a reduction in tissue elasticity. Certainly all cardiovascular disease cannot be explained in this simplistic fashion, and other predisposing factors must also exist; nevertheless, it is interesting to note that a gross parallel could be drawn between the increased incidence of coronary artery disease and myocardial infarction in urban centers and the increased ambient levels of electronic smog in these environments.

Having drawn this parallel in 1972, Zaret was puzzled when, more than a year later, he read a front-page story in the *Times* about the efforts of the Finnish government and the World Health Organization to study and deal with arteriosclerosis in North Karelia and Kuopio, two rural districts in southeastern Finland, whose five hundred thousand inhabitants had been found to experience the highest rate of heart attack in the world. The article, which was written by Lawrence K. Altman, appeared in the *Times* on September 16, 1973—a month before the start of the Warsaw symposium—and part of it read:

The fact that North Karelia has the highest incidence of heart attacks is a paradox.

Heart attacks have come to be considered a disease of stress in industrialized urban societies. Typically, they are thought of as striking overweight people who seldom exercise, sit behind desks at work, and drive home to watch television.

But North Karelia is a serene lake-land, forested with firs and pines, resembling Maine. Farming and lumbering are the bases of the economy. Hard physical work is the way of life. Yet heart attacks fell robust Finnish lumberjacks like timber.

According to Altman's account, Finnish health officials had decided that increased cholesterol levels, cigarette smoking, and high blood pressure were the most important risk factors in

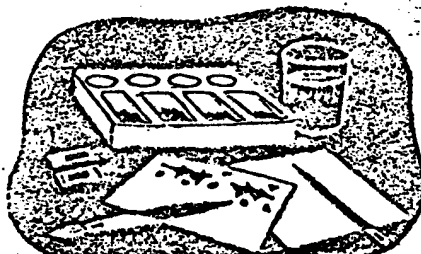
afflicting the inhabitants of the area. Altman wrote that "the predominant weight of scientific evidence points to the North Karelian diet, which is high in dairy fats and contains few vegetables, as the primary risk factor for the rising number of heart attacks." He then described the efforts of the Finnish government to encourage the inhabitants of North Karelia to cut down on their fat intake, to quit smoking, and to have their blood pressure checked at community screening centers.

After reading the *Times* article, Zaret looked at a map that accompanied it, and, struck by the fact that North Karelia was situated along the Soviet border to the northwest of Leningrad, and opposite Lake Ladoga, he found himself wondering if electromagnetic radiation from some large Soviet communications center might be contributing to the incidence of heart attack among the people of the district, who were obviously already at high risk because of their eating and smoking habits. (Six months later, he learned from a former communications-intelligence expert with knowledge of the area that radiation was probably emanating from a powerful over-the-horizon radar complex, whose transmissions were being reflected and enhanced by the surface of Lake Ladoga to achieve long-distance, low-trajectory microwave beams that, bouncing off the layers of the ionosphere, would enable the Russians to detect missiles launched from underground silos in the American Midwest and West.) Since Zaret had been invited to attend the symposium in Warsaw, he decided, on the basis of his hunch, to go by way of Helsinki, where he spent two days conferring with a doctor from the Finnish government's community-health program in North Karelia and with scientists from the electrical-engineering department of the Helsinki University of Technology. While Zaret was in Finland, he learned that Kuopio and North Karelia had not only the highest but also the most rapidly increasing rate of heart attack in the world, and that younger and younger people, including many children, were being afflicted as time went on. He

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heart attack among inhabitants of the two districts rose in direct proportion to how close they lived to the Soviet border. Increasingly certain that his theory had merit, he flew on to Warsaw to attend the symposium, where he took ten of the twenty minutes he had been allotted for the presentation of a paper on microwave cataracts to propose that electromagnetic radiation emanating from the Soviet Union might be a factor in the unusually high rate of heart attack in Kuopio and North Karelia, and to urge that the World Health Organization expand the scope of its existing study of the inhabitants of the two districts in order to investigate this possibility.

BY all accounts, Zaret's suggestion was received in silence by the delegates to the Warsaw symposium, who may well have thought they were being asked to consider not a medical hypothesis but a science-fiction scenario. Whether it turned out to be based on fact or fantasy, however, Zaret's theory served as an uncomfortable reminder to the scientific community in the United States that after twenty years of knuckling under to the military and refusing to give serious consideration to the possibility that low-level microwave radiation might produce harmful biological effects, and after a decade of dismissing and even belittling evidence gathered here and abroad in support of such a prospect, it was now embarking upon a new era of inquiry, which might well produce some startling results. Preliminary indications that this could be so were not long in coming. At a conference on the biologic effects of non-ionizing radiation held by the New York Academy of Sciences in February of 1974, data confirming the hypothesis that low-level microwave radiation could affect the central nervous system and behavior were presented by Dr. W. Ross Adey and other researchers from the University of California's Brain Research Institute, whose work was supported by the Navy. Dr. Adey and his associates demonstrated that exposure to weak electric and electromagnetic fields resulted in a shortening of reaction times and circadian rhythms in human beings, and also in estimates of the passage of time by monkeys, and they were able to correlate these behavioral effects with altered neurophysiological activity and with modified brain chemistry.

Even more striking evidence of possible microwave



wave radiation on behavior and brain tissue was presented by Allan H. Frey, a biophysicist, who had earlier carried out pioneering studies of the ability of human beings and animals to somehow hear or detect microwaves, and whose studies had since been corroborated by other researchers. Frey and his co-workers demonstrated that when rats were given a choice they tended to avoid irradiation by pulsed microwaves having an average power density of only two-tenths of a milliwatt per square centimetre. Frey and his associates also exposed rats to similar levels of pulsed microwave radiation after injecting them with a fluorescent dye that binds itself to proteins in the bloodstream which do not normally pass the blood-brain barrier—a unique capillary system that maintains the brain in a stable environment by preventing certain proteins and other substances from reaching it. When they did, they found that the permeability of the barrier was sufficiently altered by the radiation to allow the dyed proteins to enter the brain.

On the basis of such data, the President's Office of Telecommunications Policy felt obliged to use some circumpect language in its second annual report to Congress on the program for assessing the biological hazards of non-ionizing radiation. The report was sent to Congress in May of 1974, and it warned that preliminary indications from scattered experiments suggested that radio-frequency waves might affect the nervous system and behavior, and also normal development and growth processes, "at lower levels than anticipated in the past." After emphasizing that these findings were tentative, the Office of Telecommunications Policy proceeded from the cautious to the obvious, telling Congress that the effects of long-term, low-level exposure to microwaves and other radio-frequency radiation were not adequately known.

If anyone in Congress had cared to find out what was being done to remedy this situation, and by whom, he could have examined the research contracts being let out for the fiscal year 1975 by the dozen or so government agencies whose efforts to study the biological effects of radio-frequency waves were being coordinated by the Office of Telecommunications Policy. He would have learned that, in keeping with the recommendations of the Electromagnetic Radiation Management Advisory Council, and with long-established

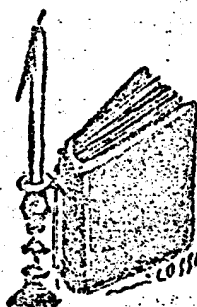
branches of the armed forces. He would also have got some idea of why the Department of Defense was so eager to study the biological effects of low-intensity microwave radiation even as it continued to claim, as it had been claiming for nearly a generation, that exposure to ten milliwatts was perfectly safe. He would have discovered, for example, that the Air Force was supporting a study of microwave effects on the embryos of zebra fish because it believed that the results might have a major impact on the setting of new standards for exposure to radar. He would have found out that the Army was sponsoring a study of the effects of microwave radiation on the brain tissue of rat embryos because it was "a major developer and user of ground-located devices using microwave beams," because "the effects on man or animals accidentally irradiated are of considerable concern," and because "adequate knowledge will allow establishment of improved safety criteria and avoid establishment of excessive restrictions on their use by other governmental agencies." As for the Navy, he would have been informed by the description accompanying the proposal to irradiate human volunteers with microwaves at the Naval Aerospace Medical Research Laboratory, in Pensacola, that "exposure of Naval personnel to microwave radiation is an acute problem," and that "even low doses are likely to reduce the efficiency of personnel in vital duty positions."

While new and much-needed research on the genetic, embryonic, behavioral, and neurological effects of microwave radiation was being undertaken, the old dispute over the role of microwaves in the formation of cataracts erupted again, triggered by the ever-controversial Dr. Zaret, who in October of 1974 published a case history in the *New York State Journal of Medicine* in which he described the development of typical microwave cataracts in the eyes of the housewife he had mentioned at the Senate hearings and also at the symposium in Poland, whose only known exposure to microwaves came from an oven that was leaking radiation. In an unusual move, the editor of the *Journal* published in the same issue a number of letters commenting on Zaret's presumptive diagnosis that the woman was suffering from microwave cataracts, and a

the comment was revealing. Confirmation of Zaret's long-held and bitterly disputed contention that microwave cataracts are a clinical entity and that they develop in the posterior capsule of the lens came from Dr. Joseph A. Bouchat, professor of ophthalmology at the Val-de-Grâce Hospital, in Paris, who, together with Dr. Claude Marsol, had made similar observations in the case of a twenty-three-year-old radar technician, and had published his findings, back in 1967, in the *Archives d'Ophthalmologie*. Criticism of Dr. Zaret's article was offered by Michaelson, of the University of Rochester, who had initially written to the editor of the *Journal* urging him not to publish it; by Osepechuk, of Raytheon; by Carpenter, of the Bureau of Radiological Health; by Dr. Donaldson,

of the Massachusetts Eye and Ear Infirmary; and by Colonel Appleton, of the Army—all of whom challenged Zaret's contention that there was such a thing as a microwave cataract, and characterized his diagnosis in the case in question as unfounded, and unsupported by medical evidence. Uncertainty about Zaret's diagnosis was expressed by Dr. George R. Merriam, Jr., of the Institute of Ophthalmology of Columbia-Presbyterian Medical Center, in New York, who based part of his doubt on the fact that microwave diathermy had been used at the institute for many years in preoperative and postoperative treatment of the eye. "The usual treatment is about one hundred milliwatts per square centimetre for twenty minutes, and treatments are often given twice a day for up to two weeks," Dr. Merriam wrote. "No adverse effects have been seen."

In his response to Dr. Merriam, Zaret suggested that a follow-up study of patients whose eyes had been treated with microwave diathermy might be valuable. "Although he reports that no adverse effects were noted, perhaps some occurred, but they were not suspected of being related to the radiation therapy," Zaret wrote. "Perhaps also no one has looked into this population grouping for the long-term or delayed effects following an acute exposure regimen of the type described." In light of the fact that for more than twenty years most doctors and scientists, including some military ophthalmologists, had considered a hundred



could at the very least be construed as a prime example of the wide discrepancies that apparently existed in the knowledge and the attitudes of various members of the medical and scientific communities toward the biological effects and potential hazards of microwave radiation.

Another example of how, when it came to microwaves, the left hand of the medical profession did not appear to know what the right was doing was provided by Dr. José Daels, of the Department of Obstetrics and Gynecology of the Maria Middelares Clinic, in Ghent, Belgium. Since 1971, Dr. Daels has irradiated two thousand women with microwaves as they were giving birth, in order to heat the uterine wall and ease the pain of labor. According to Daels, nineteen hundred and thirty-six of the women described the analgesic effect of the radiation as good. In addition to mitigating the pain of contraction, Daels' patients reported, the radiation produced an agreeable sensation of relaxation. Regarding possible adverse effects, Daels declared in an article published in the July, 1973, issue of *Obstetrics and Gynecology* that "no undesirable side effects of microwave heating of the tissues are known," and that "the very rare complications that have been reported have been due to overheating, as a consequence of incorrect dosage." He then proceeded to cite as his authority for these statements an article on the health hazards of microwaves which had been published in the United States in 1959.

DURING 1974 and 1975, the belated advent in the United States of serious research on the biological effects of low-level microwave radiation was carefully coordinated and watched over by the President's Office of Telecommunications Policy. However, in their third annual report to Congress, issued in April of 1975, the O.T.P. people were rather vague about the progress and results of a hundred-odd studies of the problem which were being conducted in various laboratories across the nation. Concerning the warning the O.T.P. had given the previous year that microwave radiation might affect the nervous system and behavior as well as processes of growth and development, it had this to say: "Continuing efforts have developed additional data in those areas. However, at this early stage, the picture is still far from clear. Information is as yet too limited to permit firm conclusions to be drawn." Later on in the report, following a description of experiments showing that low levels

of microwave radiation decreased the ability of monkeys to perform tasks, the O.T.P. declared, "There are, nonetheless, substantive indications of effects in the nervous system and behavior at this stage, warranting further investigation." Presumably, they were referring to further investigation that would either substantiate or disprove the firm conclusions that had been drawn fifteen years earlier by the Russians, the Poles, and the Czechoslovaks, whose extensive studies of the effects of long-term, low-level microwave radiation on the nervous system and the behavior of human beings and animals had led them to set standards of exposure to microwaves which were from one thousand to ten thousand times as stringent as our own. However, the authors of the report left considerable doubt about the priority assigned to this kind of investigation, saying that "there is a serious lack of long-term, low-level research due to the time, expense, and commitment required for such work, which is incompatible with the level of resources available for radio-frequency/microwave research in individual agencies at present." Besides blaming limited funds, the report noted that scientists studying the microwave problem were encountering severe problems in determining the doses of radiation necessary to cause biological effects; in understanding the interaction of microwaves with organisms at the macromolecular level; in measuring the amount and distribution of microwave energy absorbed by tissue; and in extrapolating the results of animal exposures to human beings. Whatever the obstacles, though, the 1975 O.T.P. report made one thing clear: after years of claiming that it was extremely difficult, if not impossible, to duplicate Russian experimental studies, American scientists were at last beginning to be able to confirm some of the findings of their Soviet counterparts.

In their fourth annual report, which was issued in June of this year, the O.T.P. people indicated—albeit somewhat reluctantly—that progress had been made in determining the effects of low-intensity microwave radiation on growth and development, and on the blood-forming systems, the immune system, and the endocrine system. After cautioning their readers at consider-

ably frequently, can be misinterpreted, and could lead to premature conclusions;" that all newly detected biological effects and changes are not necessarily harmful; and that consideration of new findings "must include the risk/benefits associated with EMR [electromagnetic radiation] itself and in comparison to other factors and known hazards in our lives," the authors of the report got down to specifics. "One important effect that has received increasing attention is the ability of non-ionizing EMR to stimulate division of lymphocyte cells in the intact animal," they wrote, adding that "such effects are of interest because the lymphocytes, which are a type of white blood cells, are an integral part of the body's immune defense mechanism."

In an appendix to their report, the O.T.P. people described a two-day workshop seminar that they and their colleagues on the Electromagnetic Radiation Management Advisory Council had convened in Washington, D.C., in August of 1975, to review the findings of research pertaining to the genetic, hereditary, growth, and developmental effects of microwave and radio-frequency radiation. At the meeting, the results of fifteen research projects were presented by the scientists and investigators who had conducted them. Eight of the fifteen projects showed that low-level radiation produced effects and changes in test animals or genetic material. These changes included birth defects in mouse fetuses; structural defects in darkling beetles that had been irradiated as pupae; the death of zebrafish embryos at non-thermal radiation levels; delays in the onset of normal cell division in slime mold; and marked chromosomal abnormalities in kangaroo-rat cell cultures. Apparently determined not to alarm Congress, however, the authors of the 1976 O.T.P. report summed up the workshop by stating that the results "were a mixture of positive and negative findings," and that "the largely negative findings with respect to genetic effects thus far are reassuring with regard to the magnitude of risk."

Concerning the genetic effects of microwaves, American scientists who had finally embarked on this aspect of the problem were not playing catch-up with the Soviet scientists as much as with a handful of their compatriots, whose earlier findings had for the most part been ignored. That microwave radiation might have genetic effects had first been discovered back in 1959 by Dr. John H. Heller and some associates



at the New England Institute for Medical Research, in Ridgefield, Connecticut, who observed gross chromosomal abnormalities in garlic-root tips that had been irradiated with microwaves at power levels far below those necessary to produce heat. By 1963, Heller and his colleagues had demonstrated that low-power microwave radiation could produce in mammalian cells and in insects mutations similar to those caused by gamma rays, X-rays, and ultraviolet rays. In experiments conducted with male fruit flies they clearly demonstrated that low-level microwave radiation was mutagenic at four different frequencies—in other words, that it could cause genetic damage in the sperm cells of the insects and that these mutations could be transmitted to their offspring. Ironically, when the findings of Heller and his co-workers

were published, they received more recognition in the Soviet Union than in the United States, where their data were largely dismissed or disbelieved. In any event, by the late nineteen-sixties their research on the genetic effects of microwaves had practically come to a halt for lack of interest and for want of funds.

Similarly ignored were the findings of an epidemiological investigation of radiation exposure in the parents of children with Down's syndrome, or mongolism, which was conducted between 1962 and 1964 by researchers in the Department of Chronic Diseases at the Johns Hopkins University School of Public Health and in the Department of Pediatrics at the Johns Hopkins School of Medicine, with funds from the Public Health Service. Based on the acknowledged association between Down's syndrome and leukemia, and on the acknowledged association between ionizing radiation and leukemia, the study that the Johns Hopkins scientists undertook assumed that there might be a link between ionizing radiation and Down's syndrome. They proce

therapeutic, and occupational X-ray exposures incurred by the parents of two hundred and sixteen children afflicted with the syndrome who were born in Greater Baltimore between 1946 and 1962 with X-ray exposures incurred by the parents (including age-matched mothers) of a matched control group of normal children born in Greater Baltimore during the same period. When they completed their study, they found that the mothers of children with Down's syndrome had undergone a significantly greater number of fluoroscopic examinations and more therapeutic radiation than mothers of children in the control group. Therefore, they concluded that ionizing radiation might be a factor responsible for some cases of Down's syndrome. Unexpectedly, they also discovered that although there were no discernible differences in exposures to X-rays or other ionizing radiation on the part of fathers in either group, almost ten per cent of the fathers of children with Down's syndrome reported "intimate contact with radar both in and outside of the armed

three per cent of the fathers in the control group. This development surprised and puzzled the investigators, who, although they were not willing to draw any conclusions from it, sensibly recommended in a report published in 1965 in the *Bulletin of the Johns Hopkins Hospital* that "the association between mongolism and radar exposure deserves further investigation."

Incredible as it may seem, neither the Department of Defense nor the Public Health Service saw fit at the time to institute studies to confirm or deny the startling findings of the Johns Hopkins investigators. In fact, four years went by before the military and radiological-health people got around to providing funds for the Johns Hopkins researchers to replicate their original study, to see if they could obtain the same results. And ten years went by before they got around to sponsoring either studies of the mutagenic effects of microwave radiation or epidemiological surveys to determine the incidence of birth defects among the children of men exposed to radar on military bases. By that time, it was

son, of the Air Force, told worried parents that there was little likelihood of any risk to children attending a nursery school in the basement of the ten-story building. A few days later, Embassy officials received permission from the State Department to assure all American citizens living in Moscow that no harmful radiation had been detected on the ground floor of the Embassy complex, where the snack bar and the medical dispensary are situated, or in the basement commissary. But they refused to comment on the radiation hazard existing on the upper three floors of the building, which contain most of the key offices, including that of the Ambassador. They did admit, however, that medical records of Embassy staff members and their families were being reviewed, and that white-blood-cell counts of all personnel were being taken. Meanwhile, in spite of freezing temperatures, workmen were unsealing rows of double windows throughout the Embassy and installing aluminum screens on the outside, to deflect the radiation and prevent it from penetrating the building. The installation of the screens was later said to have been approved by Secretary of State Kissinger. At the time, the Secretary contented himself with telling reporters in Washington that the United States government viewed the radiation as "a matter of great complexity and sensitivity," and that it had made "unilateral efforts to reduce the danger."

During the early days of the Moscow microwave crisis, official sources quoted in newspaper accounts were virtually unanimous in giving the impression that the Russians were irradiating the Embassy in order to activate eavesdropping devices that had been concealed in its walls and floors; that the United States government's concern about possible damage to the health of people working there was wholly preventive in nature; that the present danger, if any, was limited to mild irritability and fatigue; and that no adverse health effects caused by microwave radiation had been observed among Embassy personnel. On February 16th, however, the *Boston Globe* reported that Ambassador Stoessel was suffering from a mysterious blood ailment, resembling leukemia, that was thought to be possibly caused or aggravated by the radiation. On the same day, an Embassy spokesman made this statement: "We have seen various stories about the Ambassador's health, all of which are inaccurate and misleading. It would not be appropriate to comment

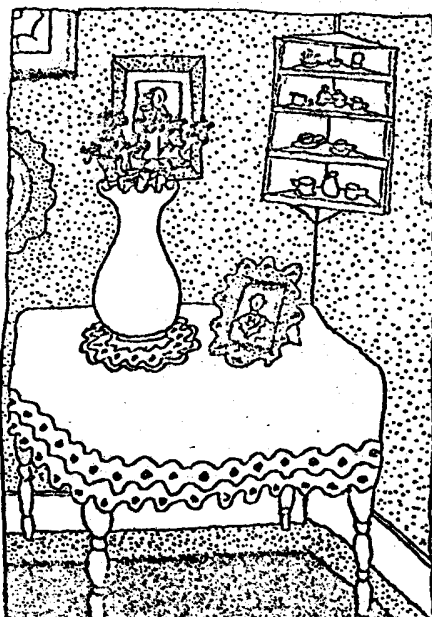
on the Ambassador's health or on that of any other individual. However, the Ambassador feels fine, keeps a busy schedule, leads an active life, has not undergone medical treatment, and is not at the present time undergoing medical treatment."

Ten days later, it was reported that the Russians had been directing radiation at the Embassy not to activate their own listening devices but to jam American listening devices that had been installed on the roof of the building. This piece of news appeared in a *New York Times* story, which also reported, "American officials said they accepted the Soviet contention that the microwaves were aimed at the Embassy to disable the sophisticated monitoring equipment and not to bug the Embassy or to harm American personnel." No explanation was offered as to why it had been deemed necessary to screen the windows of the Embassy, but one reason was not hard to infer from a paragraph that appeared in the middle of the *Times* story: "A complicating factor, officials said, was that the current ambassador, Walter J. Stoessel, Jr., had suffered nausea and bleeding in his eyes, although he was reported now feeling better. There is no evidence, officials said, that the illness was directly caused by the microwaves, but there is that possibility."

In addition to amending previous official declarations about the state of the Ambassador's health, the *Times* story of February 26th revealed that during the nineteen-sixties and the early nineteen-seventies three of Stoessel's predecessors in Moscow (two of whom have died of cancer) had protested to the Russians about radiation hazards at the Embassy. That in itself was not really surprising, since earlier

Soviet irradiation of the Embassy had been reported. However, the fact that the three ambassadors had apparently lodged their protests without informing the Embassy staff of the hazards tended to shed light on a story put out by the Associated Press on February 28th. According to the A.P. report, a former administrative officer at the Embassy whose wife had died of cancer in 1968 after working there as a secretary had sued the government, claiming that she was a victim of radiation, and had received a settlement of approximately ten thousand dollars, on the ground that she had been given inadequate medical treatment. A further indication that the government considered itself vulnerable to litigation arising from the situation in Moscow came a few days later, when Rowland Evans and Robert Novak reported in their syndicated column that high State Department officials had initially argued against making a public protest to the Russians about the radiation, on the grounds that it would compromise the Embassy's electronic-surveillance capability and "might generate damage suits against the government from Embassy employees with claims of illness."

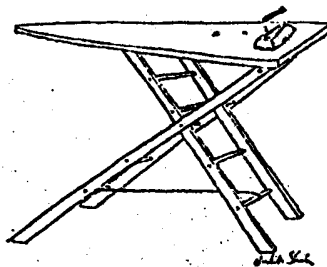
The alerting of the Embassy staff early in February to the possible dangers of microwave radiation indicated that the State Department had come to the belated conclusion that the future well-being of its employees in Moscow was more important than its liability for not having informed them about possible microwave health hazards in the past. It is apparent, however, that the State Department seriously underestimated the capacity of its employees in Moscow for being resentful and suspicious of the fact that they had been deceived about such an important matter as their health for so long a time. Indeed, resentment and suspicion fairly jumped out of the pages of a telegram that was sent to Secretary of State Kissinger on February 19th by members of the Moscow chapter of the American Foreign Service Association—a six-thousand-member organization that represents foreign-service officials around the world. The telegram, which was the result of a meeting that had been attended by some forty foreign-service employees and their spouses two days earlier, requested Secretary Kissinger to issue an unclassified written statement providing assurances that there was no evidence of any sort to suggest that any former or present employee at the Embassy had encountered health problems linked to



the Electromagnetic Radiation Management Advisory Council had issued a clear warning to the President that long-term, low-level exposure to microwave radiation could become a critical health problem if genetic effects were involved. No information has yet been made available concerning the surveys of birth defects among the children of military personnel, but the second Johns Hopkins study, which has just been completed, does not show a statistically significant relationship between Down's syndrome and parental exposure to radar. It does, however, suggest that men exposed to the emanations of radar have a significant increase in the number of chromosomal abnormalities in their blood—a finding that, since chromosomal abnormalities can cause birth defects, leaves the whole question of the genetic effects of microwave radiation in human beings open to further investigation.

Whether such investigations will be conducted more vigorously in the future than they have been in the past remains doubtful, in light of the reluctance that people in positions of responsibility for the public welfare obviously feel about pursuing inquiries into the biological effects of non-ionizing radiation which might alarm the public or embarrass the Department of Defense. Beneath this reluctance, of course, lies a deep apprehension on the part of the government and the military-industrial complex about how the citizenry and Congress will react if worst comes to worst and it turns out that exposure to microwave radiation poses a significant hazard to the health of the general population. Not surprisingly, such apprehension at the federal level has, in turn, affected the attitude of many members of the medical and scientific community, who, while trying to come to grips with the microwave problem in the laboratory, are entertaining mixed feelings about revealing the results of their work, either for fear that these will be misunderstood by the public or that money for future research might not be forthcoming. Indeed, among scientists attending the four-day annual meeting of the International Union of Radio Science's United States National Committee, which was held at the University of Colorado, in Boulder, in October of 1975, there appeared to be as much concern about possible press distortion

complex microwave problem as about the potentially adverse health effects of the microwaves themselves. Some of the scientists were concerned that the layman would not readily grasp the difference between biological effects and biological hazards. Others worried that the great potential of microwaves as a tool for studying the electrochemical workings of the brain might go undeveloped if there should be adverse publicity. Still others claimed that misinterpretation of the microwave problem by the press not only was inevitable but had already made the task of the scientific community more difficult. There was also considerable fretting about the damaging effect on public opinion of a number of disability claims that had recently been awarded by the Veter-

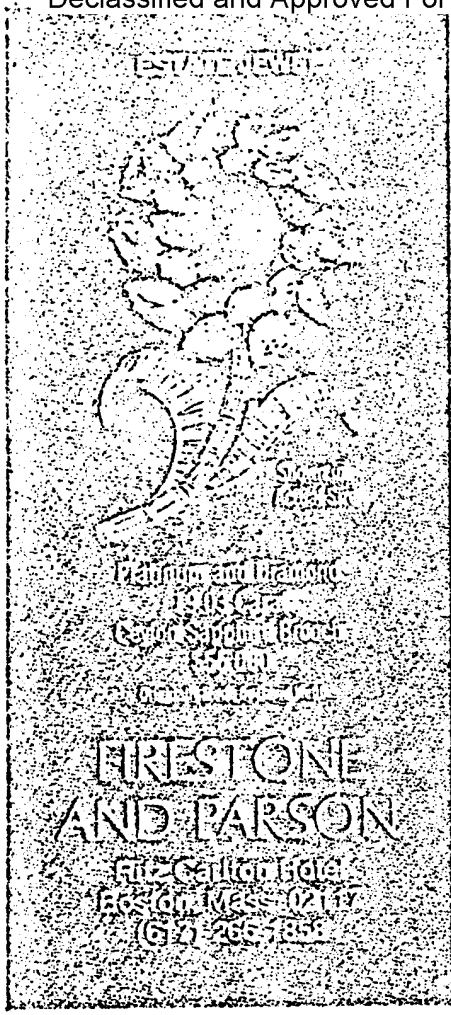


ans Administration to former radar technicians who had developed cataracts, and about the outcome of several lawsuits that had been instituted by other ex-servicemen and civilian employees of the armed forces who had been exposed to radar. Yet many of these same scientists also voiced anxiety about the extensive Soviet findings concerning low-level microwave effects, about the lack of adequate funds for microwave research in the United States, and about the absence of any well-integrated program of research within the Department of Health, Education, and Welfare. In fact, several investigators stated that because low levels of microwave radiation were known to affect the nervous system and behavior, the present ten-milliwatt standard was inadequate and would soon have to be lowered. At the same time, a journalist attending the conference was approached on several occasions by scientists and government officials, who suggested that when writing about microwaves he substitute the words "illuminate" and "illumination" for "irradiate" and "irradiation," in order not to alarm his readers unduly.

WITHIN a few months, the worrying about publicity and semantics that went on at the Boulder meeting seemed redundant in view of the news that came out of Moscow, for the disclosure in early February of this year that the Russians were once again beaming microwaves into the American Embassy, on Tchaikovsky Street; not only made headlines blaring the word

world but also touched off a spate of alarming speculation about the health effects of microwaves, which, together with a series of contradictory explanations and confusing denials issued by State Department officials, has combined to keep the story before the public ever since. According to the first report of the affair, which appeared in the *Los Angeles Times* on February 7th, Ambassador Walter J. Stoessel, Jr., had told some of the hundred and twenty-five members of his staff that the Russians were using microwave beams to listen in on conversations inside the Embassy, and that such radiation could be hazardous to their health. In the *Los Angeles Times* version, Stoessel informed the staff members that the risk was greatest for pregnant women and that other possible microwave hazards included leukemia, skin cancer, psoriasis, cataracts, and emotional illness. Although Stoessel had assured Embassy personnel that the levels of radiation to which they were being exposed were far below the minimum danger levels prescribed by Soviet occupational health regulations—an irony he appeared not to grasp—he nonetheless offered them an opportunity to transfer to posts outside the Soviet Union. He also urged them in strong terms to keep the matter secret. The *Los Angeles Times* speculated that the attempt to maintain secrecy resulted from fear that public disclosure of the radiation might damage Soviet-American relations during a delicate period when the policy of détente was under strong political attack in the United States. Whatever the reason, there was little doubt that an official lid had been placed on the story. Ambassador Stoessel and State Department officials in Washington refused to comment on any aspect of the *Los Angeles Times* report, and the day after it appeared, when President Ford was asked about it while he was campaigning in New Hampshire, he made his one statement on the subject to date. "I do not think it is a matter that should be discussed at this time," declared the President, who did not mention the fact that earlier in the winter he had written a letter protesting the radiation to Chairman Leonid I. Brezhnev. "If it is true, it is a very serious situation."

Rumors circulating among people living and working in the Embassy to the effect that they had been exposed to dangerous radioactivity quickly forced the government to abandon its policy of silence for one of partial explanation and reassurance. While refusing to discuss the situation with reporters, the Embas-



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been an unusually high incidence of spontaneous abortion among pregnant women during or after their residence at the Embassy; to describe any evidence suggesting that microwave radiation might pose a hazard for pregnant women and their unborn children; and to say whether there had been any legal actions or claims directed against the State Department for health problems resulting from service at the Moscow Embassy. The telegram asked Kissinger to explain why the employees had not been informed of the radiation problem earlier; to disclose when State Department management officials had first become aware of the "potentially harmful effects" of microwave radiation; and to say whether any previous medical tests conducted on Embassy employees had played a part in the decision to inform them of the possible hazard. The telegram also asked Kissinger to explain why metal screens had not been put over windows in the Embassy much earlier if the effects of microwave radiation could be mitigated by so simple an action.

In view of the obvious legitimacy of these requests, the State Department had little choice other than to make a public announcement in March that it would conduct a full-scale medical investigation of the thousands of Embassy personnel and their families who had served in Moscow in the past, as well as those who were serving there now. At the same time, the Department sought to allay the anxiety and soothe the anger of its Moscow employees by holding closed briefings that were designed to explain the situation. During the third week of April, Barton Rappert, a reporter for the Washington bureau of the Associated Press, obtained a copy of a confidential State Department paper that had been prepared for these briefings from an official in the Department who was concerned about how the situation in Moscow was being handled. The briefing paper said that there was no evidence of a high incidence of spontaneous abortion among women at the Embassy, and no evidence that the present levels of radiation could produce congenital malformations or have any other effect upon unborn children. It stated that between October of 1975 and January of 1976 microwave power levels had reached a maximum intensity of eighteen microwatts per square centimetre in certain heavily irradiated areas of the Embassy, and that the window screens installed since then "reduce the current microwave signals to a point well below one microwatt

had not been installed earlier, according to the paper, because before the autumn of 1975 such action had not seemed necessary. As for why the Embassy employees had not been informed about the radiation sooner, the paper explained that "until last fall, none of the experts who had studied the problem believed that it presented health hazards," and that "under the circumstances it was thought that briefing people on what little we knew of the signal would cause unwarranted apprehension on the part of those assigned to Moscow." The paper also informed the Embassy employees that "no cause-and-effect relationship has been established between disorders contracted by those in Moscow and their exposure to the electromagnetic field."

There were soon indications that such assurances did not entirely satisfy the Embassy staff members. Late in April, they were described by one State Department official as being "still very upset about the whole business." Another State Department official in Washington was quoted at the same time as saying that "the way people around here are dealing with this is just hoping that it'll be forgotten." Further suspicion about the State Department's credibility had been voiced earlier in the month by John D. Hemenway, president of the American Foreign Service Association. Hemenway expressed concern that an official coverup might be in progress and demanded that any group investigating the health situation of Embassy personnel exposed to microwave radiation include people without government ties. In a statement of rebuttal issued to the press, Lawrence S. Eagleburger, Deputy Under-Secretary of State for Management, said that Hemenway's charge of a possible official coverup was "false and reprehensible," and that "Secretary Kissinger has made clear that our principal concern is for the health and well-being of our employees in Moscow."

BY this time, it was clear that whatever the outcome of the controversy between the State Department and its employees in Moscow, a unique population of men, women, and children who had been exposed to low-intensity microwave radiation over long periods of time had been identified. It was also clear that retrospective studies of the health experience of this group of people could yield valuable epidemiological information about the possible hazards of chronic exposure to microwaves.

by the State Department was, however, another matter, for during the rest of the spring and throughout the summer the information made available to the public concerning the situation in Moscow continued to be clouded by revelations of prior involvement and previous secrecy. For example, it soon came to light that the Department's chief medical consultant in the microwave affair was Dr. Herbert B. Pollack, who had been sent to Moscow to assess the possible microwave health hazard at the Embassy even before Ambassador Stoessel told his staff about the situation. Pollack is a member of the Electromagnetic Radiation Management Advisory Council, a professor emeritus of clinical medicine at the George Washington University Medical School, and, it turns out, an old hand at the business of assessing the biological effects of microwaves. Indeed, as a member of the senior technical staff of the Institute for Defense Analyses between 1961 and 1970, Pollack was a leading participant in Project Pandora, the secret study of the effects of low-intensity microwave radiation which was mounted in 1966, when the government began to be concerned about the health implications of the Soviet irradiation of the Embassy in Moscow. The results of Project Pandora have never been revealed, for although they are said to be inconclusive, they are also classified. On May 3rd, however, an Associated Press report written by Barton Reppert quoted Richard S. Cesaro, who was in charge of Project Pandora, as conceding that some of the scientists connected with the study felt that low-intensity microwave radiation had produced signs of aberrant behavior in monkeys. "My feeling is that we probably should have continued longer with research in that area, and not necessarily concluded it that early," said Cesaro, who is now head of a communications firm in Maryland. "There were a lot of unknowns, and I don't think they were ever really put to bed." Reppert also quoted Dr. Joseph C. Sharp, who had worked on Project Pandora when he was chief of experimental psychology at the Walter Reed Army Institute of Research, as saying that "if certain kinds of restraints could have been lifted, I would have voted to go for more experiments." Sharp, who is now with the National Aeronautics and Space Administration's Ames Research Center, in California, went on to say that "part of the problem with any classified project is that you cannot talk

bunch of different kinds of ideas. . . . We always felt that we had an arm tied behind our back because we couldn't even talk to our bosses about it."

For his part, Pollack is remembered by several of his colleagues on Project Pandora as being extremely dubious about the possibility that low-level microwave radiation could affect health. In any case, when Reppert reached him at his office in the State Department in May and asked him his present opinion on the subject, Pollack replied, "That's the question they ask me upstairs here, and I can only say one answer. We just don't know." It must be surmised that the State Department has a high regard for Dr. Pollack's experience in studying the biological effects of microwaves and for his assessment of the situation at the Moscow Embassy. It appears, however, that many of the Embassy's employees do not. In their telegram to Secretary Kissinger last February, they requested "disinterested expert advice" concerning the potential health problems caused by exposure to microwave radiation "in view of widespread doubt as to Dr. Pollack's impartiality."

Toward the end of May, a new round of revelation and denial got under way when another Associated Press story by Reppert stated that recent tests conducted by electronics specialists from the C.I.A. showed radiation levels in the Moscow Embassy to be considerably higher than those found in earlier tests performed by the State Department, and that an outside telephone line had actually been found to be carrying radiation directly into the office (and, presumably, into the ear) of Ambassador Stoessel. According to the A.P. report, a State Department source said that Stoessel was "beside himself" with this latest development, and had expressed his concern in classified cables to Deputy Under-Secretary Eagleburger. A State Department spokesman, Robert L. Funseth, responded to the story by saying that Soviet microwave transmissions into the Embassy were not higher than those previously measured and by denying that the C.I.A. had conducted any separate tests. However, no one in the State Department denied any part of a Reuters dispatch carried in the New York Times on June 26th, which revealed that two children of Embassy employees had been sent to the United States for further medical study after

having been examined by doctors in Moscow. Indeed, a Department spokesman named Frederick Z. Brown said that the children had been brought home for treatment of blood disorders. According to the *Times*, Brown went on to say that extensive blood tests of all Embassy personnel had failed to establish any connection between blood disorders and the irradiation of the Embassy with microwaves.

The news about the children—two three-year-old girls who had been living in the Embassy—soon prompted additional disclosures by the State Department. On July 8th, the *Times* ran a front-page story beneath the headline "SOVIET DIMS BEAM AT U.S. EMBASSY," which began:

The United States said today that Soviet authorities in recent months had sharply reduced the level of microwave radiation beamed at the American Embassy in Moscow.

But in its first detailed public account of the situation, the State Department nonetheless rebuked the Russians for continuing the radiation even at the current insignificant level. It said this showed "a lack of concern for living and working conditions of our people in Moscow."

When asked why the Russians were being rebuked if they had cut the radiation levels below those considered by the government to entail a health hazard, Funseth replied that the continued beams caused a psychological problem. According to the *Times* account, Funseth then announced that the State Department had signed a contract with Johns Hopkins University to conduct a survey to determine whether there has ever been any connection between the microwave irradiation of the Embassy and the health of past and present Embassy employees. Shortly thereafter, it was learned that this study—a three-hundred-thousand-dollar biostatistical and epidemiological survey and evaluation of the medical records and histories of all Embassy employees and their dependents over the last ten years—was being directed and coordinated by Dr. Abraham M. Lilienfeld, professor of epidemiology at the Johns Hopkins University School of Hygiene and Public Health, who had also directed the study in the early nineteen-sixties which suggested that there might be an association between Down's syndrome and parental exposure to radar, as well as the subsequent study showing a significant increase of chromosomal abnormalities in the blood of former radar workers.

On July 10th, in his first news conference in Washington since April

ation of the Moscow Embassy, saying that "timidity or concern about our overall relations with the Soviet Union has not been a factor in this." According to an account in the *Washington Post*, Kissinger spoke in guarded fashion, referred without elaboration to "many complicated issues" in the Embassy affair, and avoided comment on reports that electronic surveillance conducted by the United States was part of the problem. "We have had to balance various advantages and disadvantages for the United States, and we have had to pay primary attention to the health of our employees," the Secretary declared.



Two weeks later, the Associated Press's indefatigable Reppert wrote a story containing a disclosure so stunning as to make one wonder how readily the men and women working for the State Department in Moscow could be led to believe that the principal concern of the Department is for their health and well-being. The story ran in newspapers across the country on July 26th, and it revealed that over an eighteen-month period in 1967 and 1968 the State Department had conducted special tests to detect genetic damage in employees returning from Moscow, and that it had not only done so without notifying the employees about the purpose of the testing but had deliberately misled them into thinking that the tests were being made for another reason. According to Reppert's account, analysis of the special tests had been conducted by Dr. Cecil B. Jacobson, of the George Washington University Medical School, who told Reppert that the results had been inconclusive. However, Dr. Thomas H. Gresinger, who is also a member of the faculty of the medical school, told Reppert that Dr. Jacobson had described the tests to him as showing "funny results—lots of chromosome breaks." Gresinger has since recalled how he first became aware of the nature of the tests that were being conducted on the Embassy employees returning from Moscow. "I had just finished my residency in gynecology and was starting up a private practice," he said not long ago. "I was teaching at the university medical school, and, to make ends meet, I was also doing consulting work for the medical division of the State Department. One day, while reading *Pap smears* at the division, I heard some lab technicians joking about some subterfuge that was taking place. According to the technicians, they had

been instructed to take buccal smears their routine homecoming physical examinations and to tell them that they were being checked for some kind of abnormal bacteria. When I heard the words 'buccal smears,' my ears pricked up. Buccal smears are never used to culture bacteria; they're a scraping taken from inside the mouth and they're designed solely for the purpose of detecting chromosomal abnormalities. Naturally, the next time I went to George Washington I looked up Cecil Jacobson, who was head of the cytogenetics laboratory over there, and asked him what was going on. Jacobson replied that there was a lot of radiation at the Moscow Embassy, that he was looking for chromosome breaks in the returning employees, and that he was finding them in significant numbers."

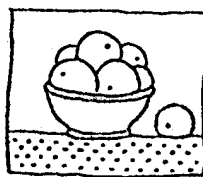
During the late summer and early autumn, the furor over the situation in Moscow diminished somewhat, probably because the attention of the press and the public was focussed on the Presidential election and its aftermath. In September, however, Ambassador Stoessel left Moscow because of health problems and was reassigned as Ambassador to West Germany. And on November 12th, the State Department issued an administrative notice declaring Moscow to be an "unhealthful post."

AS might be expected, the policy of the government toward the possible health hazards posed by low-level microwave radiation—a policy that, by and large, has ranged from evasion and obfuscation of the problem to outright suppression of medical data relating to it—has had many complicated ramifications. The fact that this policy has been invoked in the name of national security has made it a relatively easy one to justify and to carry out. It has also provided a convenient umbrella for the vast electronics and defense industries, since the government could not very well consider microwave radiation of ten milliwatts or less to be safe all those years for military and Embassy personnel and at the same time consider it to be hazardous for civilian workers engaged in the manufacture, testing, and repairing of microwave-emitting devices such as radar, communications transmitters, missile guidance systems, microwave ovens, and other equipment generating electromagnetic energy.

As a result, there have been disastrous consequences for some of the em-

ployees of the military-industrial complex who performed these tasks. One example is provided by the health experience of a number of workers who were involved in the Air Force's electromagnetic-pulse, or EMP, project—a multimillion-dollar testing system that was devised in the nineteen-sixties by the Air Force Weapons Laboratory and was operated under contract with the Air Force Space and Missile Systems Organization primarily by the Boeing Company, of Seattle, in order to simulate the pulses of radiant energy accompanying nuclear explosions and to determine the effects of the electric fields of those pulses on the warheads and guidance-and-control systems of the nation's thousand-odd Minuteman intercontinental ballistic missiles in underground silos. In spite of the fact that little was known about the biological effects of chronic exposure to pulsed electric fields, Boeing and the Air Force conducted extensive EMP tests on missile sites between the autumn of 1968 and June of 1972, using ground-based pulse generators as well as huge airborne pulsers (called big zappers by the men who worked with them), which were carried aloft by Army H-47 Chinook helicopters. As early as 1971, Boeing was aware that there had been two cases of leukemia and one case of skin cancer—all three occurring in men in their thirties or forties—among a group of seventeen technicians who had been conducting EMP tests at missile sites near the towns of Brady and Cascade, in Montana. In April of 1972, however, Boeing filed a petition with the Department of Labor's Occupational Safety and Health Administration requesting promulgation of a standard for exposure to EMPs which would be identical to one the Air Force had proposed several months earlier—an exposure level fifty to a hundred times as high as the level employed by the company. The petition informed the administration that "such action, if approved, will permit Boeing and other private employers to continue to support programs vital to the national security without having to individually establish the propriety of their activities with regard to fulfillment of their duty under Section 5 (a) (1) of Public Law 91-596." Public Law 91-596 is the Occupational Safety and Health Act of 1970, and Section 5 (a) (1) requires each employer to furnish his employees with "employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical

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Occupational Safety and Health Administration—which was advised in the matter by representatives of the Department of Health, Education, and Welfare's National Institute for Occupational Safety and Health (NIOSH) and by the members of the American National Standards Institute subcommittee that had been set up to determine safe levels of human exposure to electromagnetic radiation—turned down the Boeing petition, on the grounds that "the need for a standard regulating employee exposure to EMPs has not been shown" and that "the scientific information necessary for the development of a standard currently does not exist."



side.

Meanwhile, two more cases of cancer had occurred among people who had been exposed to EMPs at missile sites in Montana. An Air Force safety officer in the EMP program, who had been stationed at Malmstrom Air Force Base, in Great Falls, had developed leukemia and died of it, and a twenty-nine-year-old guard employed by Boeing at one of the sites had developed bladder cancer. Moreover, a family of four who lived on a ranch close to a missile site where EMP tests were conducted had developed a variety of complaints that provide an eerie echo of the symptoms first reported by the Russians in their early examinations of workers exposed to the emanations of radar and other electromagnetic devices. The family's complaints include loss of hearing, loss of memory, loss of hair, loss of appetite and weight, premature aging, low blood pressure, blood disorders, blurred vision, thyroid problems, dizziness, fatigue, and headaches. These people have made claims against the Air Force for damages. In addition, two of the cancer cases are scheduled for hearings in Workmen's Compensation Court.

Another example of how the military-industrial complex has used national security to thwart inquiry into the biological effects of electromagnetic radiation occurred at a Philco-Ford Corporation plant in Philadelphia, where during the late nineteen-sixties two men in their thirties, who had been among a group of twenty-three technicians testing microwave-generating equipment for a highly classified Army operation called Project Tempest, developed brain tumors. In December of 1970, officials of the Pennsylvania Department of Environmental Resources, who had learned of the brain tumors

to investigate the situation, but were told by a Philco-Ford supervisor that no information about Project Tempest could be given out unless security clearances were obtained through proper channels. Describing this encounter in a report a few days later, Dr. Shiro Tanaka, the chief of the department's Plant Health Services Section, wrote, "I felt something like touching an unidentified object through ten layers of thick blanket." Dr. Tanaka pointed out in a subsequent report that the male death rate from brain tumors in Pennsylvania was three and a half for every hundred thousand men in the population, and that two cases in a group of twenty-three was "almost twenty-five hundred times as many as expected."

In March of 1971, a story in *Medical World News* said that the equipment the twenty-three technicians had been working with "appears to be an electronic detection system ordered by the National Security Agency, which monitors worldwide communications." The article quoted Edward J. Baier, who was then director of the Pennsylvania department's Division of Occupational Health, as saying that the entire matter had been placed under heavy security. It also quoted officials of Philco-Ford as insisting that radiation was no problem in the plant; that the two cases of brain tumor were no more than a "statistical curiosity;" and that fears among electronics workers were caused by rumors.

Since then, almost no information has been made public concerning Project Tempest or the health experience of the men who worked on it. It is known, however, that during the nineteen-sixties and the early nineteen-seventies Philco-Ford manufactured components of the Integrated Wide-Band Communications System, which consisted of immensely powerful, two-hundred-and-fifty-thousand-watt microwave transmitters, powerful amplifier tubes, thirty-yard-wide receiver antennas, and a variety of multiplexing gear for sorting out signals on various channels. It is also known that the National Security Agency has deployed this system in many countries around the world, in order to detect, record, and send back to the United States telecommunications and radar signals transmitted by Communist nations. Moreover, it has come to light that during an eleven-month period in 1967 and 1968 three men in their forties and fifties who were members

of a group of about twenty technicians engaged in setting up IWCS microwave-generating equipment on the border between Thailand and Laos and Cambodia dropped dead of coronary attacks.

Still another example of how the military-industrial complex has managed to ignore the hazards of electromagnetic radiation occurred at the Naval Air Station at Quonset Point, Rhode Island, where three civilian employees among a group of eight technicians who were engaged in the overhaul and repair of Tactical Airborne Navigation equipment (known as TACAN), which is similar to radar in operation, either have developed cancer or have died of it since 1970. One of these men died of lung cancer in 1970; another died of cancer of the pancreas, lungs, and liver in 1973; and the third man, who left the Naval Air Station in 1973 to work on TACAN for the Federal Aviation Agency, has been found to have cancer of the pancreas, lungs, and liver. The fact that the man who died of cancer of the pancreas was only thirty-one years old, and the fact that the man who is ill with the disease is only thirty-five, is highly unusual, for ninety-nine per cent of all reported cases of pancreatic cancer occur in people over forty, and most of them occur in people in their fifties and sixties. But the fact that these two men worked side by side at a test bench at the Quonset Naval Air Station for several years is severely disturbing, for it is believed that no two cases of pancreatic cancer occurring among men working in such close proximity have ever been reported before. Equally disturbing is the way this situation is being handled by the Navy and by NIOSH. After learning of the two cases of pancreatic cancer, in the autumn of 1975, the NIOSH people in New England made a survey of the problem in their area and recommended in a report dated January 13th of this year that an "aggressive study" be undertaken of the hazards of occupational exposure to microwave energy. The report also says that the Department of Defense "is very interested in pursuing a study with NIOSH in order to determine the extent of microwave energy contribution to pancreatic cancer," and goes on to recommend that future microwave surveys at military installations be coordinated with officials of the Department of Defense.

Just what such coordination might entail became clear at a two-hour

Washington. According to a bureau report dated August 17th, this meeting was held to discuss "alleged carcinogenesis resulting from exposure to microwave radiation," and was attended by six officers from the Bureau of Medicine and Surgery, three of whom were physicians; the physician in charge of the Electromagnetic Radiation Project Office of the Naval Medical Research and Development Command; three officials from NIOSH; a statistician from the National Academy of Sciences' National Research Council; and a Navy lieutenant commander representing the President's Office of Telecommunications Policy. The report goes on to say that searches of the medical literature undertaken by two of the conferees show "no prior evidence that microwave exposure is related to development of cancer." The next paragraph of the report reads:

At the heart of the TACAN instrument is a klystron tube which not only produces microwave radiation but also ionizing radiation in the form of X-rays. Considerable shielding and other safety devices make X-irradiation of users negligible and microwave radiation is below maximum permissible levels. Should the shields be removed and the instrument energized during a repair procedure, exposure to X-rays would be possible. The F.A.A. prohibits such practice. The work procedures at [the Naval Air Station at] Quonset Point are not known at this point.

According to the report, the conferees ended the meeting by agreeing that "NIOSH would alert the Navy of any F.A.A. decision" in the case of the former civilian employee of the Navy who is suffering from pancreatic cancer; that NIOSH would obtain a detailed description from this man of his work practices while he was employed by the Navy and by the F.A.A.; that the Navy would "endeavor to identify TACAN repairmen at all Navy Air Rework Facilities," and to obtain information on deaths among civilian workers at all Navy Air Rework Facilities; that representatives of the Navy's Environmental Health Center and NIOSH would tour all such facilities "to measure microwave/X-ray levels and observe work practices of those exposed to microwave/X-ray, including TACAN repairmen;" and that this would be done in a way "to avoid alarming TACAN workers unduly."

It is not clear why the work practices at the Quonset Naval Air Sta-

tion are unknown to the Navy. It is known, however, that the patient in question gave an account of these work practices to representatives of NIOSH back in November of 1975, which included the information that he and his fellow-employees at the Naval Air Station often worked on unshielded TACAN power tubes; that the Navy shipped these tubes in packages containing no warning that they could emit X-rays; but that TACAN power tubes packaged and shipped by the F.A.A. did contain such warnings. It is also known that as early as August of 1960, at the fourth and final Tri-Service conference on the biological effects of microwave radiation, Colonel George M. Knauf, the conference chairman, had told an audience that included high-ranking officials from the Army, the Navy, and the Air Force and representatives from some of the largest electronics companies in the nation that there was a "vitally important problem of X-ray exposure" in the operation of high-power tubes used in radar, and that "a recent unfortunate accident has again emphasized the need to keep this area of personnel risk in the foreground in our programs of personnel instruction." This accident involved several technicians at a General Electric Company test facility near Lockport, New York, who were irradiated with X-rays generated by the klystron tube of a radar that G.E. was developing under contract to the Air Force.

Starting in the nineteen-sixties, manuals issued to Navy personnel contained warnings that high-voltage tubes used in radar could also produce X-rays, but whether the Navy has any real intention of protecting its personnel and its civilian employees from the hazards of microwaves, X-rays, and other electromagnetic radiation seems somewhat doubtful when one considers a Bureau of Medicine and Surgery in-

struction sent on March 28, 1974, to all Navy ships and stations having medical personnel. The instruction announced that henceforth the bureau's Radiation Effects Advisory Board would act as a consultant to the Surgeon General in the evaluation of "alleged or true radiation exposure to personnel injury involving claims against the government." It further ordered that "no local authority shall make any statement or release any in-



continued

related injuries, actual or alleged, without consulting the Radiation Effects Advisory Board." The reason given for the order provides a classic example of the motives of the military-industrial complex in suppressing information about the health hazards of electromagnetic radiation:

In the past, responsible medical department personnel have made statements or signed certificates which indicated a causal relationship between radiation exposures and physical defects that could not be substantiated by existing facts or documents. This has led to unwarranted public and employee concern and apprehension. Merely including radiation exposure information in association with personnel injury or illness may be misconstrued by a patient or the public as indicating causal relationship. The resulting public apprehension could seriously jeopardize the military and civilian nuclear power programs. Therefore, in all illnesses or injuries allegedly associated with radiation, the significance of any radiation exposure shall be carefully evaluated and documented.

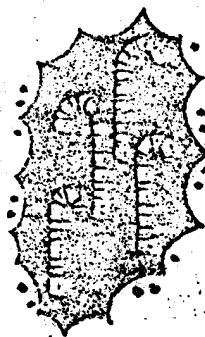
WHAT the government has done all along, of course, is to extend the presumption of innocence to low-intensity microwave radiation even as it was supposed to be encouraging an intensive investigation of the biological effects of such radiation. This situation has created a strange and often uncomfortable climate for members of the medical and scientific community who have been given government funds to study the problem. It has, for example, created a climate in which, over nearly a decade, a number of leading microwave scientists have received government research money to investigate the biological effects of low-level microwave radiation even though during this entire period they have publicly disparaged the possibility that such effects might exist. It has created a climate in which it has been

possible for Colonel Appleton, chief of ophthalmology service at the Walter Reed General Hospital, to testify in behalf of a microwave-oven manufacturer in a court case involving the alleged development of microwave cataracts. It has created a climate in which the Bureau of Radiological Health is only just now getting around to proposing performance standards for the fifteen-thousand-odd microwave-diathermy devices that are used to treat some two million Americans each year, even though the bureau has known for

devices could cause cataracts, and even though it has known for two and a half years that pregnant women are not allowed to be occupationally exposed to microwaves in Poland, because five cases of birth defects have been known to occur as a result of microwave-diathermy treatments. It has created a climate in which the Occupational Safety and Health Administration not only lacks proper and sufficient equipment to measure radiation being emitted by thousands upon thousands of microwave and radio-frequency heating devices used in industry but has even thrown up its hands over the problem to the extent of declaring that employers have "the primary responsibility for determining the level of risk to workers exposed to microwaves." It has created a climate in which—except for a study recently undertaken by the National Academy of Sciences to compare the health and death records of twenty thousand Korean war veterans who were exposed to radar with the records of twenty thousand veterans who were not exposed—not a single epidemiological investigation similar to the investigation undertaken in the Soviet Union and other Eastern European countries has ever been conducted in the United States to determine the long-term health experience of hundreds of thousands of civilian and military radar technicians, microwave workers, and microwave-appliance makers, as well as television, radio, and other communications personnel, all of whom are occupationally exposed to microwave radiation.

And, finally, it has brought about a situation in which man, for the first time in his evolutionary history, has been subjecting himself to levels of microwave and radio-frequency radiation that are millions of times as high as those occurring naturally in the biosphere, and doing so without having any idea how such radiation may affect him, let alone how it may affect future generations.

To be sure, the fact that the military-industrial complex has gone to extraordinary lengths for nearly twenty years to stifle inquiry that might turn up evidence of health hazards from exposure to low-level microwave radiation does not in itself provide evidence that chronic exposure to such radiation is biologically harmful. It does, however, suggest that there are a lot of people in this country with power and money who are sufficiently caught up



in, considers and corporate profit to be in no great hurry to find out about the matter one way or the other. Indeed, the reason the military and the electronics industry are in close cooperation over what to make public about the health effects of microwaves is nowhere more clearly stated than in a report entitled "Biological Effects of Electromagnetic Radiation (Radiowaves and Microwaves)—Eurasian Communist Countries," which was prepared for the Defense Intelligence Agency by the Army Medical Intelligence and Information Agency. This report was issued in March of this year as a classified document containing "recommended reading material for those consumers who have an interest in the application of microwave energy to weapons;" however, most of its contents were declassified in November, after Barton Reppert wrote letters to the Pentagon requesting that it be made public under the Freedom of Information Act. After acknowledging in a summary section that microwave exposure standards in Communist countries "remain much more stringent than those of the West," the report warns, "If the more advanced nations of the West are strict in the enforcement of stringent exposure standards, there could be unfavorable effects on industrial output and military functions." It then goes on to present the rationale that "the Eurasian Communist countries could, on the other hand, give lip service to strict standards, but allow their military to operate without restriction and thereby gain the advantage in electronic warfare techniques and the development of anti-personnel applications."

The rest of the document is a compendium of obviously deliberate but unintentionally comic contradiction, misinterpretation, and omission. The first page of the summary says, for example, that "Eurasian Communist countries are actively involved in evaluation of the biological significance of radiowaves and microwaves," while the next states, "No significant research and development has been identified that could be related to work in this field in the People's Republic of China, North Korea, and North Vietnam." Further, the entire middle section of the report, which is entitled "Biological Significance of Radiowaves and Microwaves," turns out to be little more than a general review of well-known studies conducted by scientists in the Communist countries between 1968 and 1975. Most of these studies have been pub-



countries in support of the strict standards of exposure to microwave radiation enforced in them; they have been presented and discussed at a number of internationally attended scientific meetings; and until recently many of them were either dismissed or discounted by a great majority of the scientists in the United States who were investigating the biological effects of microwaves. However, it is in the final paragraph of a section entitled "Trends, Conclusions, and Forecast" that the authors of the report achieve their most significant omission, for in their zeal to expose the machinations of the "Eurasian Communist investigators" they manage to avoid any mention of the fact that virtually all the work whose usurpation by the Communists they are suggesting, and whose potentially disastrous consequences they are describing, was originally conducted by Allan Frey, published in the medical literature in the United States, and financed by the Office of Naval Research. The paragraph reads:

No Eurasian Communist research activity has been identified which can be clearly or directly related to any military offensive weapons program. However, Soviet scientists are fully aware of the biological effects of low-level microwave radiation which might have offensive weapons application. Their internal sound perception research has great potential for development into a system for disorienting or disrupting the behavior patterns of military or diplomatic personnel; it could be used equally well as an interrogation tool. The Soviets have also studied the psychophysiological and metabolic changes and the alterations of brain function resulting from exposure to mixed frequencies of electromagnetic radiation. One physiological effect which has been demonstrated is heart seizure. This has been accomplished experimentally in frogs by synchronizing a pulsed ultrahigh frequency microwave signal of low-average power density with the depolarization of the myocardium and beaming the signal at the thoracic area. A frequency probably could be found which would provide sufficient penetration of the chest wall of humans to accomplish the same effect. Another possibility is alteration of the permeability of the blood-brain barrier. This could allow neurotoxins in the blood to cross. As a result, an individual could develop severe neuropathological symptoms and either die or become seriously impaired neurologically.

No one knows to whom the authors of the next Defense Intelligence Agency report on radio waves and microwaves will attribute the most recent experiment conducted by Frey, let alone how dire they will imagine its consequences to be, for during the past year he has found that pairs of caged

male rats, which are accustomed to fight viciously when their tails are pinched, accept pinching of their tails with relative passivity when they are being irradiated with pulsed microwaves in the ultrahigh-frequency television range at a power density of one milliwatt per square centimetre. However, none of this should be taken to mean that the Russians may not be up to no good with their use of microwave and radio-frequency radiation. A report published in the *New York Times* on October 30th of this year revealed that in recent months a mysterious broadband, shortwave radio signal has been broadcast intermittently from the Soviet Union. The signal is so powerful that it has disrupted radio and telecommunications throughout the world, but despite complaints from other countries, from the Federal Communications Commission, and from the International Telecommunications Union, the Soviet transmissions have continued. Dr. Zaret is concerned about the signal not because of its interference with radio and telecommunications but because of its potential for being hazardous to human beings. "This broadband signal is being pulsed at an on-off rate of ten times per second," he said the other day. "When I analyzed the Soviet literature for Project Pandora back in the nineteen-sixties, it was very clear that such an encoding impressed onto carrier wavelengths could have a central-nervous-system effect. In the case of the present signal, I would not be surprised to find that the on-off code at a repetition rate of ten per second could have an effect on the brain's inherent alpha rhythm. So whatever purpose the Russians may have for continuing this transmission, the potential effect in human beings from altering their alpha rhythm cannot be discounted. The Soviets should not be permitted to pollute our atmosphere with this signal any more than they should be permitted to continue irradiating our embassy in Moscow."

THE trouble with a policy such as the one implemented by the military-industrial complex regarding the health effects of microwave radiation—a policy based on suppressing and delaying the emergence of data—is that it cannot always be adjusted to conceal the haphazard revelations that are bound to occur from time to time. This proved to be the case again and again during the Watergate affair—most notably when a chance question revealed the existence of the Presidential tapes—and it may prove to

be the c Declassified and Approved For Release 2012/05/10 : CIA-RDP88B01125R000300120113-6 all and the State Department to assuage the anxiety of its employees in Moscow by claiming that the window screens it ordered installed at the Embassy had reduced the power level of microwave radiation there from a maximum of eighteen microwatts per square centimetre to less than one. If this claim is true, it places the government of the United States in the untenable position of having taken measures to protect the health of a few hundred people living in Moscow from levels of microwave radiation to which, as it has good reason to suspect, millions upon millions of American men, women, and children are being exposed every day.

Ironically, one of the few assessments of the extent of this exposure comes from the Raytheon Company, whose wholly owned subsidiary Amana Refrigeration is the largest manufacturer of microwave ovens in the world. Back in 1973, the Raytheon research division, upset by Consumers Union's blanket "Not Recommended" edict on microwave ovens, asked one of its microwave experts, John Osepchuk, to look into the situation and, if possible, to come up with a way of countering the adverse publicity. Osepchuk produced a study entitled "Radiation Hazards of Television Broadcasting to the General Population and Comparison with Microwave Oven Hazards." Documenting his study from official government reports, Osepchuk found that, according to the President's Office of Telecommunications Policy, the thousand-odd television stations in the United States "are located in the centers of population and therefore are of prime concern as sources of biological hazard due to electromagnetic pollution." He then compared the total radiated power and energy of these television transmitters with the total radiated power and energy that would be put out by a million microwave ovens operating for half an hour a day, and determined that "the television broadcast industry irradiates the country and its population by a factor of more than forty thousand greater than the radiation due to microwave ovens."

Later in his study, Osepchuk quoted the Federal Communications Commission as saying that it had issued no regulations governing television-broadcast radiation, "because the health hazard from such radiations has not been defined, and because the equipment over which it has jurisdiction has tended to be constructed and operated in such a manner that significant practical radiation hazards have not been known to

"Estimate of Television Broadcast Radiation in U.S. Homes," however, Osepchuk revealed that there is considerable evidence that a large part of the population may be subjected to levels of television radiation as high as one microwatt per square centimetre, and that a smaller, but still large, part of the population may be exposed to several milliwatts per square centimetre—"particularly those residing or working in high-level apartments or offices in cities." Osepchuk then referred to the 1973 Office of Telecommunications Policy annual report, which states that "levels of two milliwatts per square centimetre or higher in nearby high structures" will exist in cities near television transmitters. He also disclosed that it had long been known in government circles that microwave radiation generated at television frequencies could penetrate deeply into the body and affect the central nervous system.

Although Osepchuk's study was never formally published or distributed by Raytheon, a measure of the anxiety in government circles over the amount of microwave radiation in urban areas can be determined by the fact that the Environmental Protection Agency's Office of Radiation Programs has been hard at work for more than a year measuring the intensity of the radiation being emitted by television and radio transmitters in major cities across the United States. Using a specially built radiation-monitoring van, the E.P.A. people have already completed surveys in Miami, Philadelphia, New York, Chicago, Boston, and Atlanta, and the metropolitan area of Washington, D.C. Few data from the program have been made public as yet, but the E.P.A.'s measurements of microwave-radiation levels in the nation's capital are consistently higher than those taken by the Bureau of Radiological Health in a similar survey five years ago.

Not surprisingly, Osepchuk concluded his report for Raytheon by observing that if low-level microwave radiation proved to be biologically harmful there would be a far greater hazard to the general population from television than from microwave ovens. As things turned out, he and his employers need not have worried, for, in spite of Consumers Union's non-recommendation (which was reaffirmed in June of this year) and in spite of the manufacturers' having been forced

repair thousands of microwave ovens that were discovered to be leaking radiation in excess of the five-milliwatt level, sales of the ovens have exceeded the most optimistic estimates of their makers. According to a recent article in the *Sunday Times*, which appeared under the headline "Microwave Sales Sizzle As the Scare Fades," more than eight hundred thousand microwave ovens, valued at three hundred and sixty million dollars, were sold in the United States in 1975—a year in which, for the first time in history, the sales of microwave ovens exceeded the sales of gas ranges. Whether microwave ovens, which are still allowed by federal regulations to leak as much as five milliwatts of radiation after purchase, are safe or not is obviously open to question, since no one knows what constitutes

a safe level of exposure to microwave radiation, and since the average housewife cannot have the vaguest notion of how much or how little radiation her microwave oven may be leaking. The manufacturers of these appliances, for their part, continue to claim that it is perfectly safe to allow children to watch food cooking through the oven windows. Not so long ago, however, it was considered perfectly safe to allow children to study the bones of their feet in the viewing windows of fluoroscope machines in shoe stores all over the country.

Though almost no one believes that microwave radiation will turn out to have the same potent biological effects associated with X-rays and other ionizing radiation, the fact is that no one has the slightest idea what the long-term, low-level effects of microwaves will be. At any rate, if microwave radiation should turn out to have irreversible biological effects, it may well be too late to do much about it. Indeed, given the mass addiction to television, and the widespread use of microwaves in all manner of communication, it seems questionable whether today's society would even want to do much about it. It is entirely possible that, regardless of how bad the situation may turn out to be, microwave radiation might pose a hazard people will choose to tolerate and continue to live with. That this possibility exists, however, is hardly a reason for the public not to have been adequately informed about the potential danger posed by microwave radiation long before the radiation had pro-



literated to its present state of ubiquity in the urban environment, where it must now be accepted simply because submission is the only choice.

Needless to say, in order for the public to be adequately informed about any technological hazard prior to its becoming pervasive—after which, of course, the people can merely cross their fingers and hope for the best—there has to be a free and enlightened scientific community, whose members are not only permitted but encouraged to think the unthinkable, if only in order to design a full range of experiments. This, of course, has not been the case with microwave radiation. Still, it is interesting to speculate about what might have happened if, instead of scorning mavericks like Zaret, laughing at pioneers like Frey, succumbing to the military's Cold War outlook, and worrying about possible misinterpretations by the press, the scientific community had undertaken to follow the Soviet lead and had seriously studied the biological effects of microwave radiation fifteen or twenty years ago, when the first disconcerting signs that something might be wrong appeared. It seems likely that at the very least such an endeavor might have prevented the government from placing itself in the position of perhaps having to install window screens for half the urban population. At best, it might have alerted the public long before now to assert its inalienable right to know, and to question the conspiracy of silence about the potential hazards of microwave radiation—a policy that the government was able to maintain for years on the very basis that the public, according to the parlance employed by military and intelligence people in matters deemed to involve security, had "no need to know." If this had been the case, it might not have been left to a handful of foreign-service officials and their wives to remind the nation that it is always eminently sensible to question government policy in any area that may affect the well-being of the people.

—PAUL BRODEUR

(This is the second part of a two-part article.)